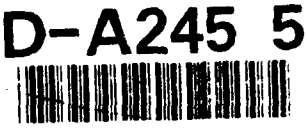

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Monterey, California

THESIS

Physical Readiness Testing of Surface Warfare Officers

by

William Decker Hatch II
and
Lori Danette Swinney

June 1991

Thesis Co-Advisor: Alice M. Crawford
Thesis Co-Advisor: Mark J. Eitelberg

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This study focused on the appropriateness of the Navy's physical readiness test (PRT), particularly as it applies to surface warfare officers (SWOs). Physical requirements of fleet SWOs were addressed through two separate surveys and an extensive literature review. Differences in fleet PRT requirements and physical requirements set forth by SWO accession sources were also examined. Further review of literature allowed for evaluation of the individual components that currently comprise the PRT, in addition to possible alternatives. Methods of body fat measurement were also presented. Finally, situations which lead to difficulties in the administration of the PRT were assessed, including deployments, scoring of the PRT, medical waivers, and attitudes and perceptions of Navy members concerning the PRT. Based on information obtained in these areas, recommendations were made for changes in accession requirements, PRT components, and PRT administration.

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Physical Readiness Testing of Surface Warfare Officers

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ABSTRACT

This study focused on the appropriateness of the Navy's physical readiness test (PRT), particularly as it applies to surface warfare officers (SWOs). Physical requirements of fleet SWOs were addressed through two separate surveys and an extensive literature review. Differences in fleet PRT requirements and physical requirements set forth by SWO accession sources were also examined. Further review of literature allowed for evaluation of the individual components which currently comprise the PRT, in addition to possible alternatives. Methods of body fat measurement were also presented. Finally, situations which lead to difficulties in the administration of the PRT were assessed, including deployments, scoring of the PRT, medical waivers, and attitudes and perceptions of Navy members concerning the PRT. Based on information obtained in these areas, recommendations were made for changes in accession requirements, PRT components, and PRT administration.

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I. INTRODUCTION

A. OVERVIEW

In an effort to ensure operational effectiveness, officers in the United States Navy are compelled to achieve and maintain standards of physical readiness, and are encouraged to participate in a lifestyle that promotes good health. Physical fitness is first stressed at accession points, where future officers are required to demonstrate some level of physical competence before receiving their commission. However, the need for physical fitness does not end here. Throughout their naval careers, officers will be required to perform a wide variety of tasks that require strength, endurance, flexibility, and a significant aerobic capacity.

It is precisely this collection of attributes that the Navy's Physical Readiness Test (PRT) seeks to verify. Twice a year, officers and enlisted personnel are measured and tested to determine their level of fitness in terms of hip and back flexibility, upper and lower torso muscular strength, aerobic and cardiorespiratory endurance, and body fat composition. Individuals' performance results in each of these areas are combined to give an overall fitness rating, which can range from failure to outstanding.

This means of testing Navy officers must be scrutinized to decide if the measured areas of performance provide a true indication of an individual's fitness level. For example, many members spend little or no time preparing for the PRT, and on test day, they "gut it out." Nevertheless, they are able to achieve a passing, if not exceptional, score. Also, under the current method of scoring the PRT, a superior performance in one test category can compensate for a minimal showing in others, and lead to an overall score

that may not actually reflect the fitness status of a member. Both of these situations indicate potential problems concerning the individual events and evaluation of PRT performance.

Perhaps a more important issue concerns the appropriateness of each test component as a measure of fitness, considering the physical tasks that an officer must undertake. Each PRT category has been developed for a specific purpose [Ref. 1]. For example, flexibility is associated with a decrease in the risk of injury, and lower torso endurance is identified as an important predictor in the prevention of lower back injury. Upper torso endurance is needed for pushing, pulling, lifting, and carrying. Aerobic fitness is important during activities which require sustained performance demanding the use of large quantities of oxygen. Therefore, if an officer can successfully fulfill the requirements in each of the PRT components, does it indicate that he or she is capable of adequately performing all physical tasks required of the billet being filled?

The body composition portion of the PRT also deserves attention. Body composition, or percent body fat, is defined as the percentage of the body that is composed of fat tissue [Ref. 1]. Because minimal body fat is associated with reducing the risk of hypertension, high cholesterol, and cardiovascular disease, the Navy has developed body fat standards by which its members must comply. Body composition is determined by the measurement (with a tape measure) of various body circumferences of the individual. This method of determining body fat is questionable in some cases, due to differing body types and accuracy of the measurements [Ref. 2, 3]. Another concern surfaces if a member is found to be overfat or obese. Does such a diagnosis indicate the individual is not capable of performing the physical activities associated with a particular job?

B. PURPOSE

This thesis examines each element of the PRT and determines the appropriateness of the test as it applies to Surface Warfare Officers (SWOs). The physical job-task requirements of SWOs are assessed, and these requirements are compared with the fitness standards emphasized by the PRT. Congruity is at issue. This study explores the PRT objectives and standards, and determines if they are sufficient to support physical tasks performed by SWOs.

The consistency between the physical requirements set forth by SWO accession points and those of the PRT is also addressed. The differences between accession point and fleet physical requirements are identified and analyzed.

The PRT is further analyzed independent of its relationship to fleet requirements. This comprehensive assessment examines body fat measurement and the adequacy of each PRT component as a measure of physical fitness. Administration difficulties are also introduced, including scheduling complications, inconsistencies in testing procedures, and medical waivers. Finally, this thesis summarizes the results from these areas of study, and concludes with recommendations for changes in the structure and administration of the PRT.

C. PHYSICAL READINESS TESTING PROGRAM

The PRT is designed to test an individual's physical readiness in the categories of flexibility, muscle endurance, and aerobic and cardiorespiratory endurance. Guidelines for administration and scoring of the PRT are set forth by OPNAVINST 6110.1D, Physical Readiness Program [Ref. 1]. This instruction explains the correct procedures used to screen PRT participants, administer the test, and record and evaluate PRT scores. Procedures for

managing individuals medically excused from the PRT are also described by this document.

1. **Screening**

Proper screening of all command members must take place 10-12 weeks prior to the administration of the PRT to determine eligibility for participation in the test. The screening process requires form OPNAV 6110/2, Risk Factor Screening/Physical Readiness Test Results, to be completed by an Authorized Medical Department Representative (AMDR), the member, and the Command Fitness Coordinator (CFC). (See Appendix A.) Four phases define the screening process.

a. Current Physical Examination

Members are required to have a current physical examination to participate in the PRT. Upon completion of a physical examination, the AMDR enters the date of the member's examination, and the date of the next required examination in the member's OPNAV 6110/2. The AMDR will also indicate if the member is medically cleared to participate in the PRT.

b. Risk Factor Questionnaire

Members must complete the risk factor questionnaire by answering each question with a YES or NO response. A YES response to any question indicates a significant change in that particular area since the last physical examination or PRT. If a member answers YES to any of the questions, he or she must obtain clearance from an AMDR to participate in the PRT.

c. Body Composition

Members are measured for height, weight, body circumferences, and percent body fat. Body fat is determined by measuring the member's height, neck and

abdominal circumference (men), or height, neck, waist, and hip circumference (women). Percentages for body fat are obtained by performing calculations with these measurements and finding the appropriate numerical value in the height measurement chart in OPNAVINST 6110.1D. If the body fat percentage is between 22 and 26 percent for men, or between 30 and 36 percent for women, the individual is declared overfat, and the member is placed on a mandatory physical fitness program. Men and women with body fat percentages equal or greater than 26 percent and 36 percent, respectively, must be examined by an AMDR to confirm obesity. Only an AMDR can diagnose obesity or release a member from a diagnosis of obesity. Any member who is diagnosed as obese will not be allowed to take the PRT.

d. Medical Referral and Medical Evaluation

Members who do not have a current physical examination, answered YES to any of the risk factor questions, or exceed body fat percentages must be referred to, and evaluated by an AMDR. The referral/evaluation procedure also includes those members who were not cleared to participate in PRT in their latest physical examination. If a member falls in one of these categories, only the AMDR can clear the member for participation in the PRT.

2. Testing

The PRT consists of four events: sit-reach, curl-ups, push-ups, and the 1.5-mile run/walk or 500-yard swim. These test components are be taken in the order listed, with no less than two minutes and no greater than fifteen minutes rest between each event. Failure to meet the standards for any of the four events constitutes a failure of the entire PRT.

a. Sit-reach

The sit-reach is designed to test the flexibility of the hip and back. It is performed by sitting on the ground with the legs straight, feet together, shoes off, and toes pointed up. The member must slowly reach forward and touch the toes with the fingertips of both hands, simultaneously. The legs must be kept straight, and the ankles must remain at a right angle. Bouncing or lunging is not allowed. This event is scored PASS if the member is able to touch his or her toes and hold the reach for one second. Three attempts are allowed. Members fail this portion if they are unable to touch their toes.

b. Curl-ups

Curl-ups are used as an indicator of muscular endurance of the abdominal muscle group. To correctly execute this event, a member must begin by lying flat on his or her back, with knees bent and heels approximately ten inches from the buttocks. Arms are folded across the chest, and a partner holds the member's feet to the floor. The member then curls up, touching elbows to thighs, and then lies back, with shoulder blades touching the ground. This procedure is repeated as many times as possible in a two-minute time period. Resting is allowed in the up or down position at any time during the event.

c. Push-ups

Push-ups serve as an indicator of upper torso muscular endurance. They are performed by first having the member assume a front leaning position, with a straight back, and the member's full weight resting on the hands and toes. The hands should be approximately shoulder width apart. The elbows are then bent and the body is lowered until the top of the upper arms, shoulders, and lower back are parallel to the ground. The member returns to the starting position by extending the elbows until the arms are straight.

This procedure is repeated as many times as possible in a two-minute time period. Throughout the test, the arms, back, buttocks, and legs must form a straight line, from head to heels. Resting is allowed in the up position only, but the straight line must be maintained.

d. 1.5-Mile Run/Walk or 500-Yard Swim

The purpose of the timed run/walk or swim is to determine the cardiorespiratory endurance of the member. This run/walk consists of continuously running and/or walking a 1.5-mile course. Any combination of running and walking is allowed.

If facilities are available, a member may instead choose to perform the 500-yard swim. Diving starts are not permitted, but swimmers may push off from the ends of the pool with their hands and feet at the end of each lap. Any swim stroke is allowed, and resting without forward progress is permitted by holding the pool side, treading water, or standing on the bottom of the pool.

3. Scoring

The PRT is scored on a point system. Points are awarded for performing curl-ups, push-ups, and the run/walk or swim. To pass the PRT, participants must achieve an established minimum number of points in each event, and successfully execute the sit-reach. Failure to meet the minimum requirement in any event constitutes failure of the entire PRT.

As the number of curl-ups and push-ups performed increases, so does the number of points awarded in each category. Similarly, a faster run/walk or swim time will also result in a greater number of points for that event. Each test component is scored as failure, satisfactory, good, excellent, or outstanding, based on the individual's

performance in the event. The final score of the member is obtained by totaling the points achieved in each category. This point total determines the overall classification (failure, satisfactory, good, excellent, outstanding) of the participant. The required number of points for each category is based on a participant's age and sex. For example, a 25-year-old man must perform 52 push-ups (85 points) to receive a score of outstanding for that category. However, a 25-year-old woman must do 29 push-ups (62 points) and a 35-year-old man must do 45 push-ups (78 points) to achieve the same score. (Appendix B includes tables which set forth requirements for each test component based on age and sex.)

Upon completion of the PRT by command members, the CFC is required to document the results of the PRT in the member's 6110/2. Command performance is summarized on the OPNAV 6110/1, Command Physical Readiness Test Summary, which is submitted to Naval Military Personnel Command (Code 68) by 30 September of each year.

4. Medical Waivers

An individual may be granted a medical waiver from all or part of the PRT if an AMDR concludes that he or she is unable to safely participate in or complete the test due to documented medical conditions. Waivers may be granted only by an AMDR, and medical conditions that preclude participation are re-evaluated by an AMDR before each official PRT. Release from a medical waiver may be granted only by an AMDR.

At the time a waiver is granted, the medical condition is documented in the member's SF 600, Health Record-Chronological Record of Medical Care, and in the member's 6110/2. This individual is then referred to a medical officer who has specialty training in the area for which the waiver has been granted. If a medical waiver is granted for one or more portions of the PRT for three consecutive official PRTs, the member may

be referred to a medical board by the commanding officer, based on the recommendation of a medical specialist.

Medical waivers are granted for pregnancies. Upon confirmation of pregnancy, the woman is routinely exempted from physical fitness testing. Additionally, body fat assessment is waived from the time of diagnosis until six months following delivery. A pregnant woman may wait up to six months after delivery to take an official PRT.

II. THE SURFACE WARFARE OFFICER

The advent of technology has witnessed the decline of human muscular strength and endurance as ultimate determinants of naval superiority. Nevertheless, the necessity of maintaining a physically fit Navy has remained. Even today, those assigned to shipboard duty will engage in routine and emergency activities which place rigorous demands upon the human body. The unique structures and capabilities of Navy vessels require that crew members be strong and able-bodied. This chapter examines the importance of physical fitness aboard ships, particularly among the assigned officers. Background information concerning this issue is first presented. This is followed by the description, results, and discussion of two separate surveys of surface warfare officers, each of which addresses SWO physical fitness and the physical readiness test. The final section of this chapter addresses the opportunity provided to surface warfare officers to become physically fit aboard a ship.

A. BACKGROUND

Much of the information concerning physical fitness of Navy members assigned to ships focuses on enlisted personnel. Indeed, these individuals will be most likely to involve themselves in physically demanding job tasks, such as loading ammunition and mooring lines. Robertson identified eleven basic body efforts (BBEs) which encompass the muscular demands of almost all job tasks for enlisted shipboard personnel [Ref. 4]. These efforts are: lifting without carrying, carrying while walking, carrying while running or swimming, pushing (repetitive), pushing over a distance, pulling, squeezing, turning a

lever, turning a wheel, swinging (repetitive), and swinging for distance. Additionally, Robertson and Trent developed and validated a strength test battery (STB) for the purpose of determining rating specific task performance standards in combination with a procedure to determine the percentage of men and women excluded from ratings because of these standards [Ref. 5]. Beckett and Hodgdon conducted a study to "determine the extent to which performance of simulated general shipboard work can be predicted by measures of physical capacity" [Ref. 6:p. 1]. The authors claim the addition of push-ups to the physical readiness test in OPNAVINST 6110.1C indicated the Navy's desire "to provide performance standards for the PRT which relate to job performance standards" [Ref. 6:p. 2].

Despite the focus on enlisted members, Marcinik, Hodgdon, Englund, and O'Brien evaluated tasks "that all personnel could be called upon to perform at any time" [Ref. 7:p. 4]. These tasks involved opening and securing multi-dogged water tight doors, carrying a paint bucket, and extricating an injured crew member through the shoulder drag technique. Few surface warfare officers will be seen carrying a paint bucket. They are expected to be leaders and managers rather than laborers. However, "real world" situations often dictate that these individuals will find themselves performing manual labor. Webb and Pagan claim that "...more and more Navy (and Coast Guard) people spend disproportionate amounts of their careers desk-bound (whether ashore or afloat) and yet may be called upon at any time to physically exert themselves" [Ref. 8:p. 95].

Perhaps no situation better demonstrates this notion than when a ship's crew becomes involved in damage control. In his commentary, "Physical Demands of Ships' Tasks are a Factual Matter," Davis reports:

> I would like to deal with the factual matter pertaining to the physical demands of tasks required of sailors aboard combatant vessels, specifically to highly critical, commonly performed damage control tasks that can be reasonably expected of any sailor in response to shipboard emergencies in war or in peace [Ref. 9:p. 25].

On 17 May 1987, the USS Stark was struck by two Iraqi missiles which killed 37 crew members and severely damaged the ship's structure [Ref. 10]. Damage control assistant (DCA) Lieutenant William A. Conklin, recounted the firefighting and damage control efforts of Stark crew members which lasted more than 24 hours and, ultimately, saved the ship [Ref. 11, 12, 13]. Officers and enlisted personnel were forced to contend with 3,500 degree fires and make repairs in choking smoke. A 16-degree list, coupled with dehydration and fatigue, added to the difficulties encountered by the crew [Ref 10]. Ramsey's statement, "Most analysts identify endurance as the first physical requirement of combat," certainly appears to apply to the Stark incident [Ref. 14:p. 106]. In the end, officers not only managed the damage control efforts, but they actively participated in them as well.

Commander Paul X. Rinn, commanding officer of the frigate U.S.S. Samuel B. Roberts in 1988, emphasized the importance of physical fitness as well. In the February 5, 1990 issue of Navy Times, Rinn reportedly told Congress that the "exceptional physical conditioning" his crew achieved through an at-sea program, helped them save the ship after it was struck by an Iranian mine in the Persian Gulf in April of 1988 [Ref. 15:p. 25].

The importance of physical fitness again surfaces when considering episodes of sustained operations (SUSOPS). Pleban, Thomas, and Thompson conducted a study on Reserve Officer Training Corps (ROTC) cadets to evaluate the "potential moderating effects of physical fitness on cognitive work capacity and fatigue under sustained combat-like

operations" [Ref. 16:p. 87]. Their results suggest that fitness "may attenuate decrements in cognitive work capacity for certain tasks requiring prolonged mental effort, particularly as the cumulative effects of sleep loss and other stressors begin to mount." Similarly, the results suggest "as overall stress levels increase, fitness may have a beneficial effect in moderating fatigue rate" [Ref. 16:p. 86]. Surface warfare officers certainly encounter stress and fatigue in the line of duty, and their ability to make correct decisions during sustained operations may be crucial to the survival of ship and crew. According to Englund, Naitoh, Ryman, and Hodgdon, "Several factors influence the quality of sustained performance when work requirements include both physical and mental components: physical fitness/endurance training, ..." [Ref. 17:p. 2]. Similarly, in his work, "Physical Fitness as it Pertains to Sustained Military Operations," Hodgdon states that continued performance of physical tasks is affected by a number of physiological and environmental factors. In this study, he claims that "it is clear that the more fit one is (either in terms of aerobic capacity or muscle strength and endurance) the higher rate of work one will be able to sustain" [Ref. 18:p. 20]. Thus, the role that physical fitness plays in the performance of both physical and mental tasks underscores the importance of fitness among surface warfare officers. The fitness level of these officers (as indicated by the Navy physical readiness test) and their attitudes toward physical fitness and the PRT are assessed through the following two surveys.

B. SURVEYS

1. Naval Postgraduate School

a. Description

A survey was conducted in March 1991 at the Naval Postgraduate School (NPS) in Monterey, California, for the purpose of gathering information for this study. Approximately 400 survey forms (see Appendix C) were distributed to surface warfare officers attending NPS. These surveys, based on the students' most recent sea tour, incorporated the categories of age, sex, ship type, and billet. Also included in the questionnaire were the individuals' latest PRT score and body fat percentage. The survey centered around the question, "Do shipboard tasks require a higher level of fitness than required to pass the PRT?". Those who replied "yes" to this query were allowed to choose which area of fitness was not supported by the PRT. Lastly, respondents were asked to report which routine physical tasks they performed.

b. Respondents

Data from this survey were drawn from 179 respondents, only two of which were women. While none of the individuals who responded to the survey were older than 39 years, 36.3 percent were categorized in the 30- to 39-year-old age group. The remaining 63.7 percent fell in the 20- to 29-year-old group (See Figure 1).

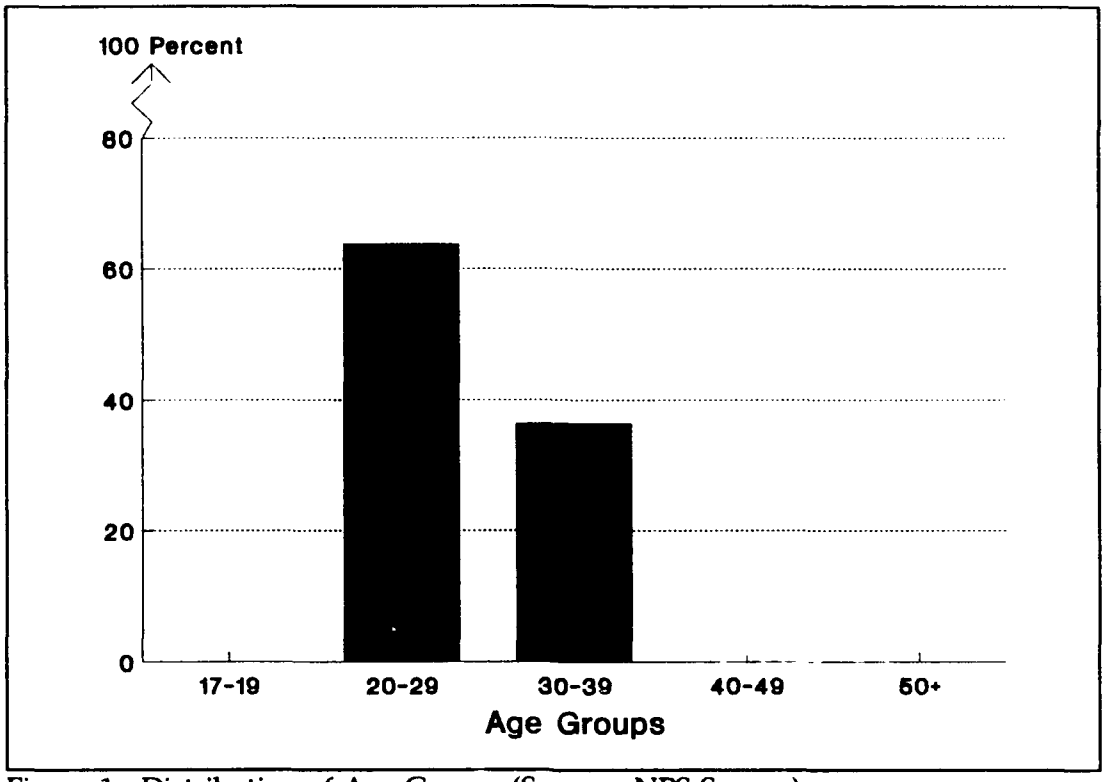

Figure 1. Distribution of Age Groups (Source: NPS Survey)

Although 21 different ship types were reported, over 75 percent of the respondents served on destroyers, cruisers, or frigates (See Figure 2). Only 6.1 percent filled administration/navigation billets, while 20.1 percent, 26.3 percent, and 47.5 percent served in operations, weapons, and engineering, respectively (See Figure 3).

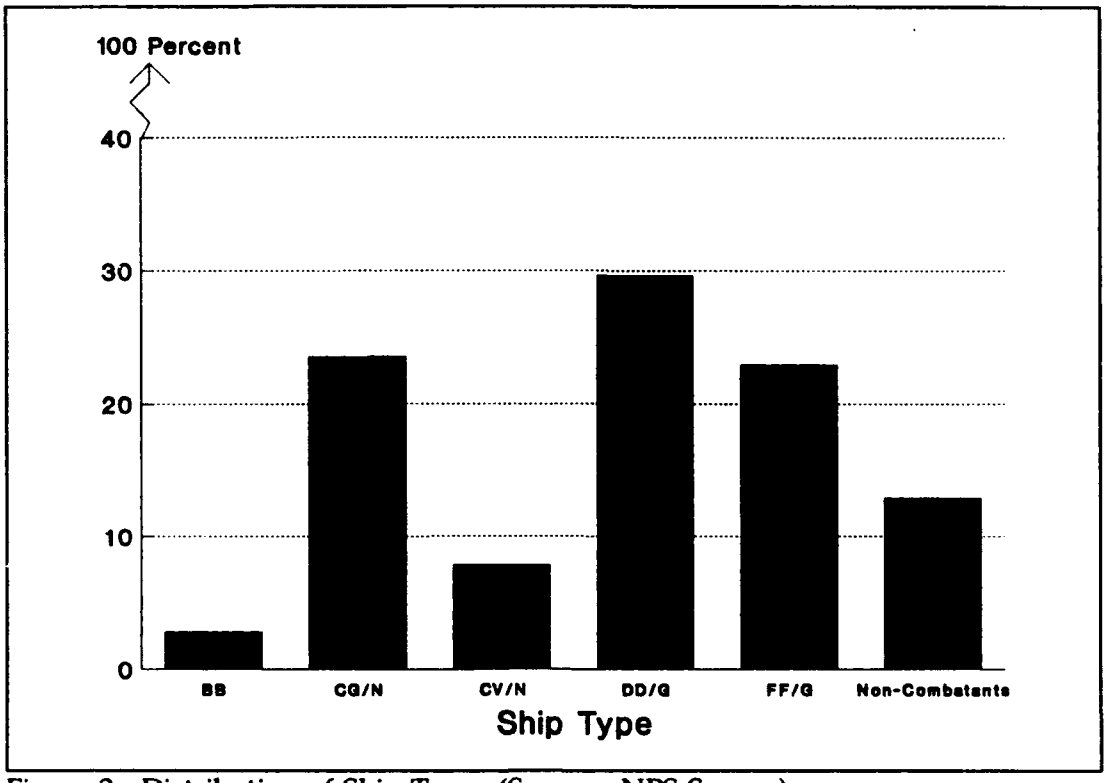

Figure 2. Distribution of Ship Types (Source: NPS Survey)

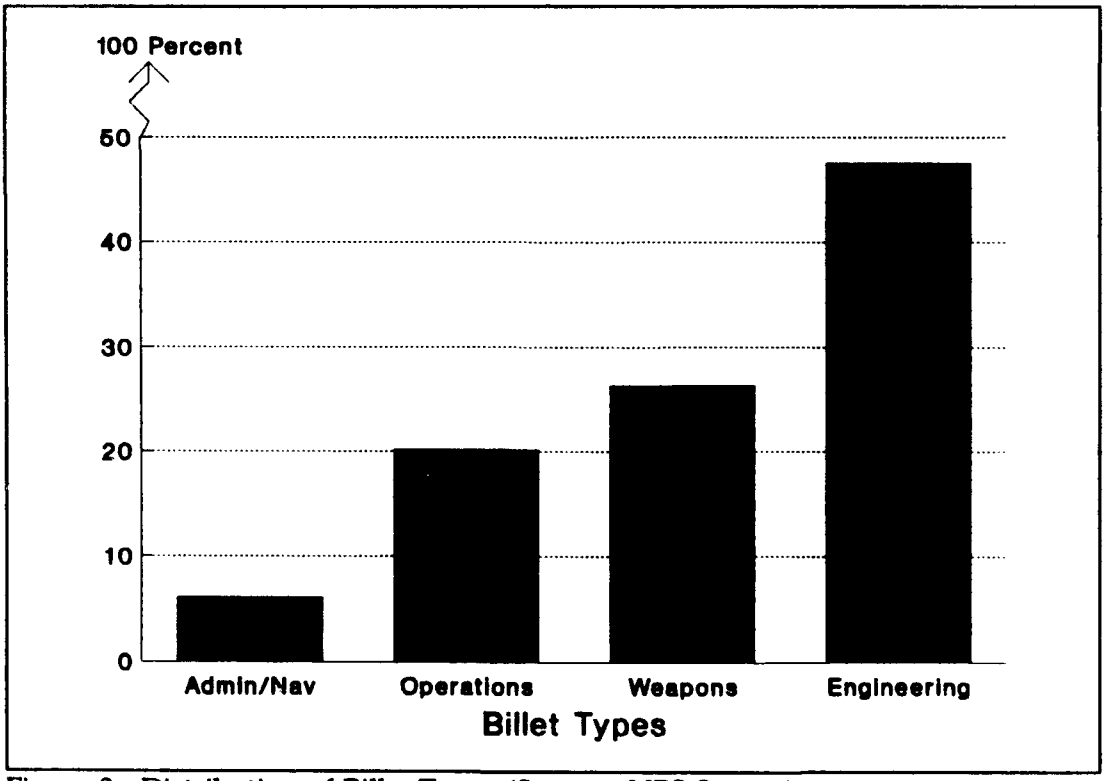

Figure 3. Distribution of Billet Types (Source: NPS Survey)

Figure 4 illustrates the distribution of respondents' PRT scores. The greatest percentage of PRT scores of the respondents were classified as either outstanding (35.8 percent) or excellent (31.3 percent). Approximately half as many reported scores of good (17.9 percent) or satisfactory (14.5 percent). Although there were no failures, one respondent (0.6 percent) was medically waived from his latest (shipboard) PRT.

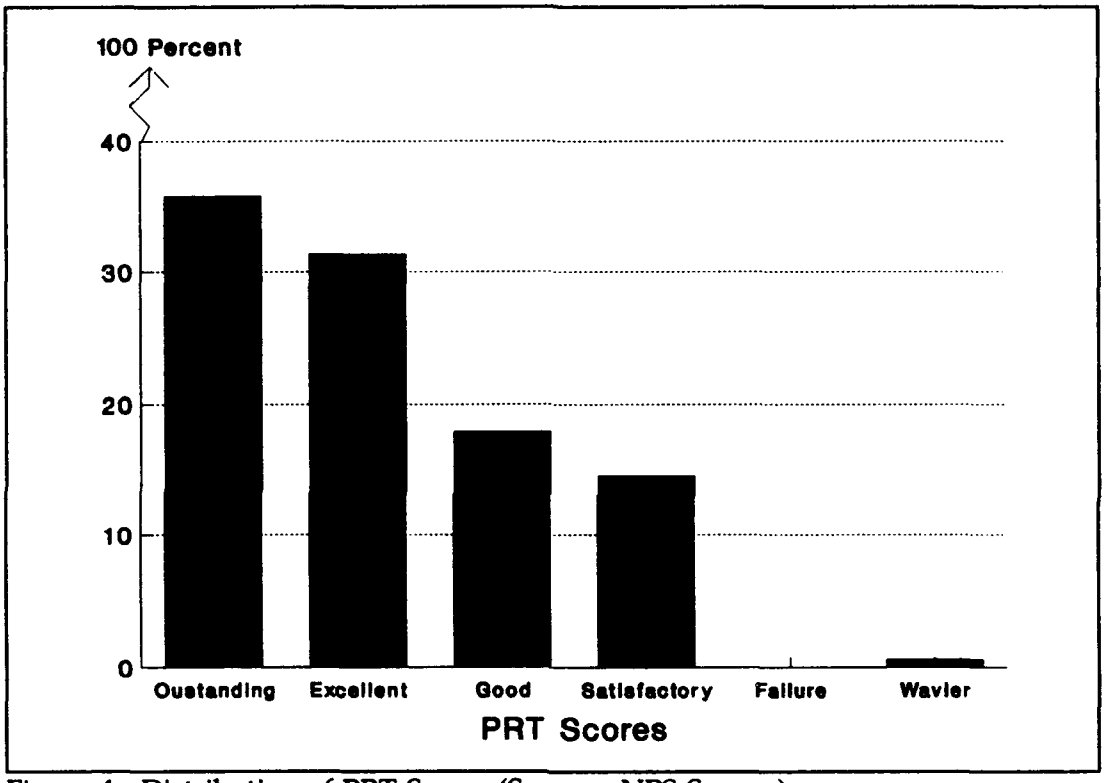

Figure 4. Distribution of PRT Scores (Source: NPS Survey)

Nearly half of the respondents (45.8 percent) claimed to have a body composition of less than 16 percent body fat. Another 34.1 and 15.6 percent fell in the 16-19 percent and 20-22 percent ranges of body fat, respectively. Three men and one woman (a total of 2.2 percent) were classified in the 23-24 percent body fat grouping, which places these three men in the "overfat" category. Two men and the remaining woman (a total of

1.7 percent) reported body fat between 25 and 30 percent, indicating obesity in the men. No individuals reported greater than 30 percent body fat. (See Figure 5)

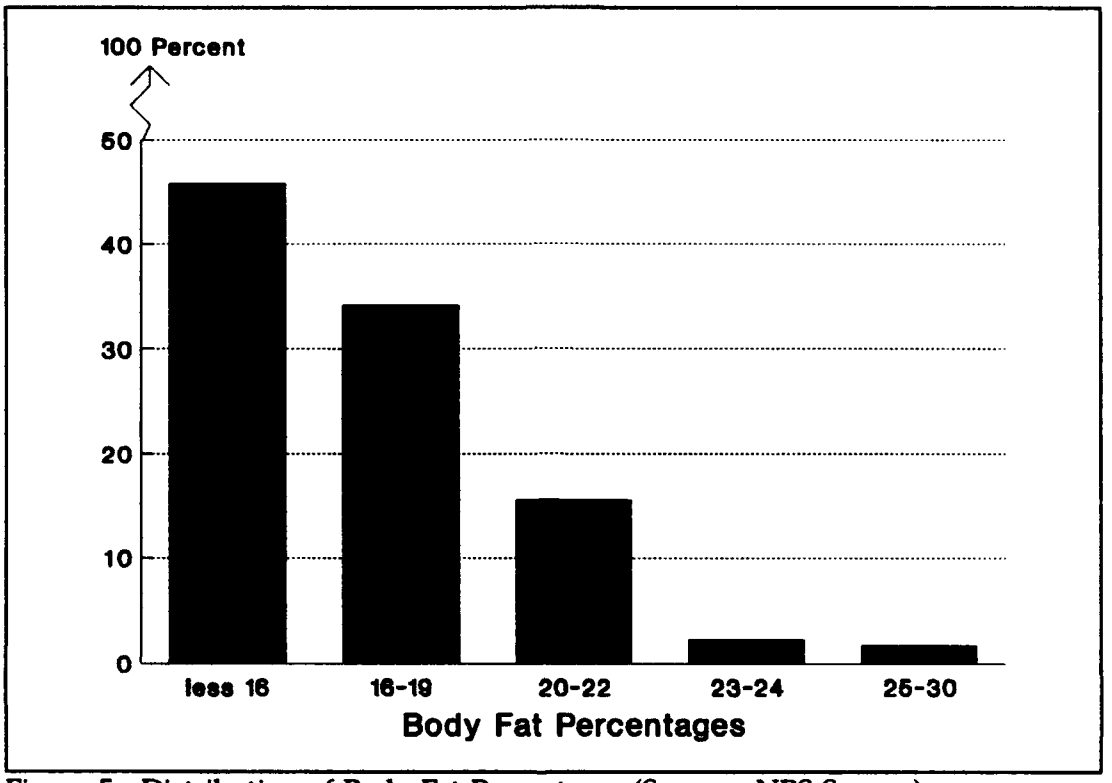

Figure 5. Distribution of Body Fat Percentages (Source: NPS Survey)

The survey participants were asked to choose from a list of routine tasks which they performed aboard ship. This portion of the survey would help identify the physical requirements of the surface warfare officer. Although five "routine task" choices were provided, the sixth choice, entitled "Other," allowed the respondents to list physical tasks they performed that were not included. This information allows for a comparison of SWO physical requirements with the testing requirements of the PRT.

Over 90 percent of the respondents indicated they stood for four or more hours at a time, opened and closed water-tight doors, hatches, and scuttles, and climbed ladders. Another 31.8 percent and 33.0 percent said they lifted and carried objects. The final task in this survey was simply listed as "Other," and respondents were allowed to write in their own choices. Although sleeplessness is not considered a physical activity within the scope of this thesis, 8.4 percent of the respondents indicated that they worked for long periods of time with little or no sleep. Another 3.4 percent said they were required to "crawl" (See Figure 6).

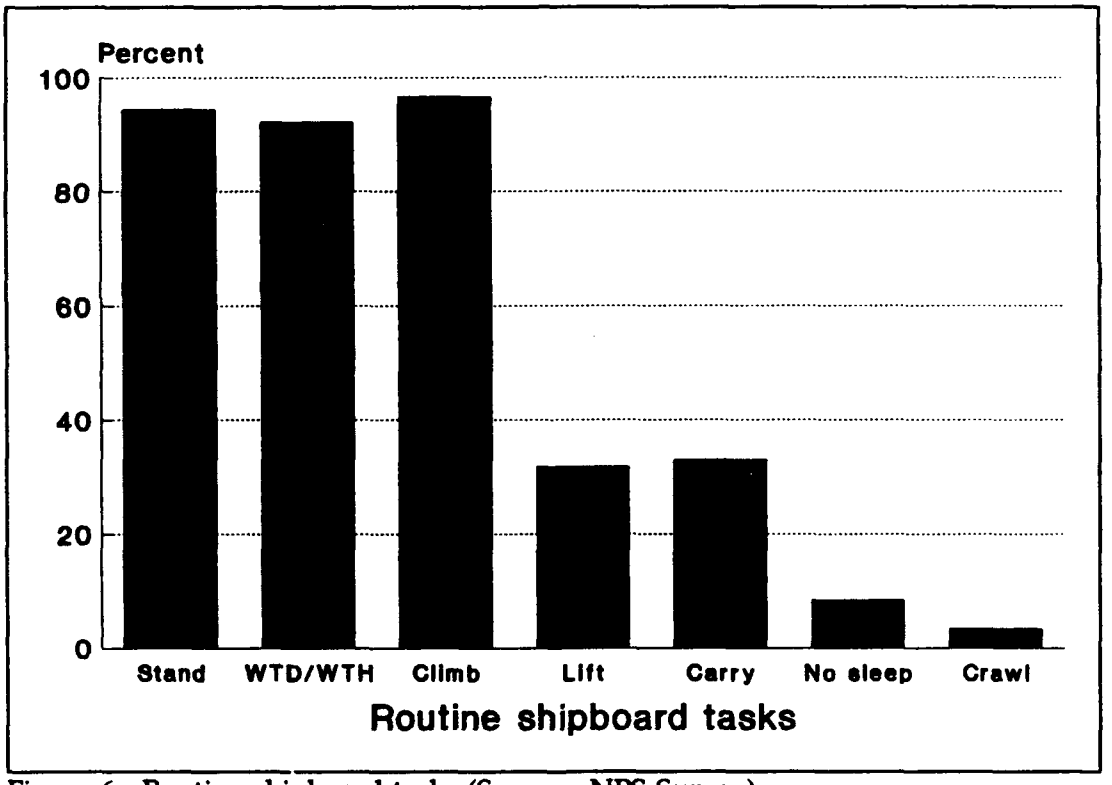

Figure 6. Routine shipboard tasks (Source: NPS Survey)

c. Results

Nearly 14 percent of those who responded to the survey indicated that shipboard tasks require a higher level of fitness than required to pass the PRT (See Figure 7). This narrowed the field to only 25 respondents.

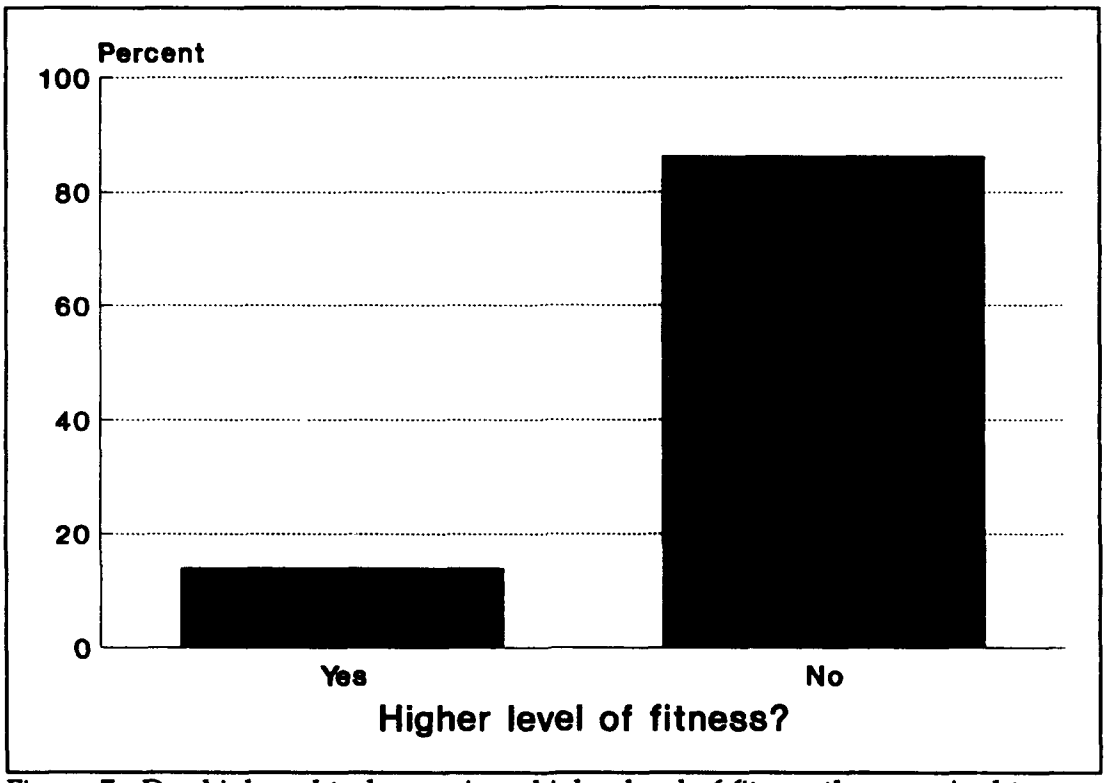

Figure 7. Do shipboard tasks require a higher level of fitness than required to pass the PRT? (Source: NPS Survey)

These 25 individuals were asked to choose which area(s) of fitness was/were not supported by the PRT. Almost half (48.0 percent) of these respondents believed that aerobic capacity was not sufficiently supported by the PRT, while 36.0 percent felt the upper body strength aspect was inadequate. Another 24.0 percent indicated that lower body strength and flexibility lacked emphasis (See Figure 8).

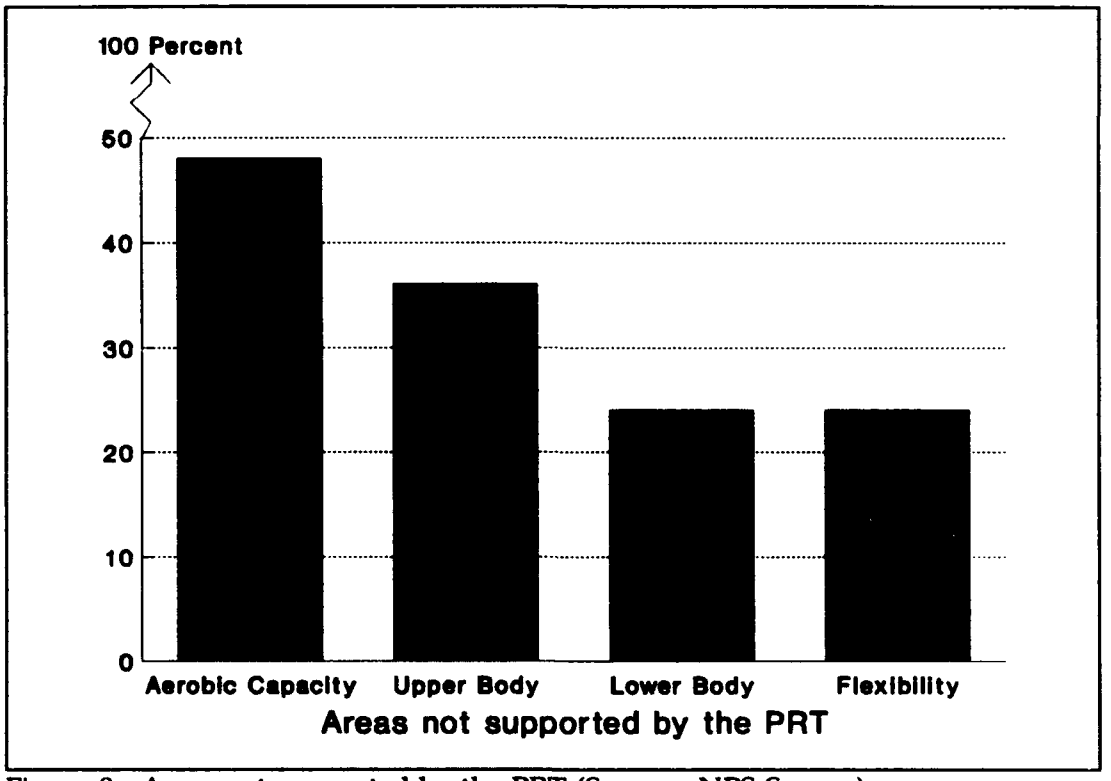

Figure 8. Areas not supported by the PRT (Source: NPS Survey)

The data from this survey were used to evaluate the characteristics of respondents who felt a passing score on the PRT did not support shipboard tasks (25 respondents). The purpose of this analysis was to determine if those individuals assigned to a particular ship type or billet, or maintaining a particular level of fitness or body composition, held the same beliefs as their fellow surface warfare officers concerning this matter.

Frequency analysis of age groups revealed 10.7 percent of the individuals in the 20-29 age group (18 of 114 respondents) and 15.8 percent in the 30-39 group (7 of 65 respondents) believed the PRT indeed did not support shipboard tasks. Also, 16.7 percent of individuals serving on CG/CGNs (7 of 42 respondents), 18.9 percent serving on DD/DDGs (10 of 53 respondents), and 9.8 percent on FF/FFGs (4 of 41 respondents)

shared similar feelings. Because each of the remaining ship types accounted for such a small portion of the total percentage, they were not included in the analysis. While none of the individuals in administration/navigation billets reported this belief (0 of 11 respondents), 17.7 percent in engineering (15 of 85 respondents), 11.1 percent in operations (4 of 36 respondents), and 12.8 percent in weapons (6 of 47 respondents) claimed the passing score did not support shipboard tasks.

The categories of PRT scores and body fat percentages were also analyzed in conjunction with the 'PRT/shipboard task' question. The proportion for each PRT category who believed the passing score is not supportive are as follows: outstanding, 18.8 percent (12 of 64 respondents); excellent, 12.5 percent (7 of 56 respondents); good, 3.1 percent (1 of 32 respondents); and satisfactory, 19.2 percent (5 of 26 respondents). Again, due to the low number of responses in the "failure" and "medical waiver" categories, these classifications were excluded from this analysis. For this same reason, the 23-24 percent and 25-30 percent body fat categories were also excluded. However, it is important to note that two of the three overfat men (23-24 percent body fat) reported that the passing score did not support shipboard tasks. The proportions for the remaining body fat groupings are as follows: less than 16 percent body fat, 18.3 percent (15 of 82 respondents); 16-19 percent body fat, 9.8 percent (6 of 61 respondents); 20-22 percent body fat, 7.1 percent (2 of 28 respondents); Figure 9 illustrates percentages for all above-mentioned categories concerning the "passing PRT score/shipboard tasks" issue.

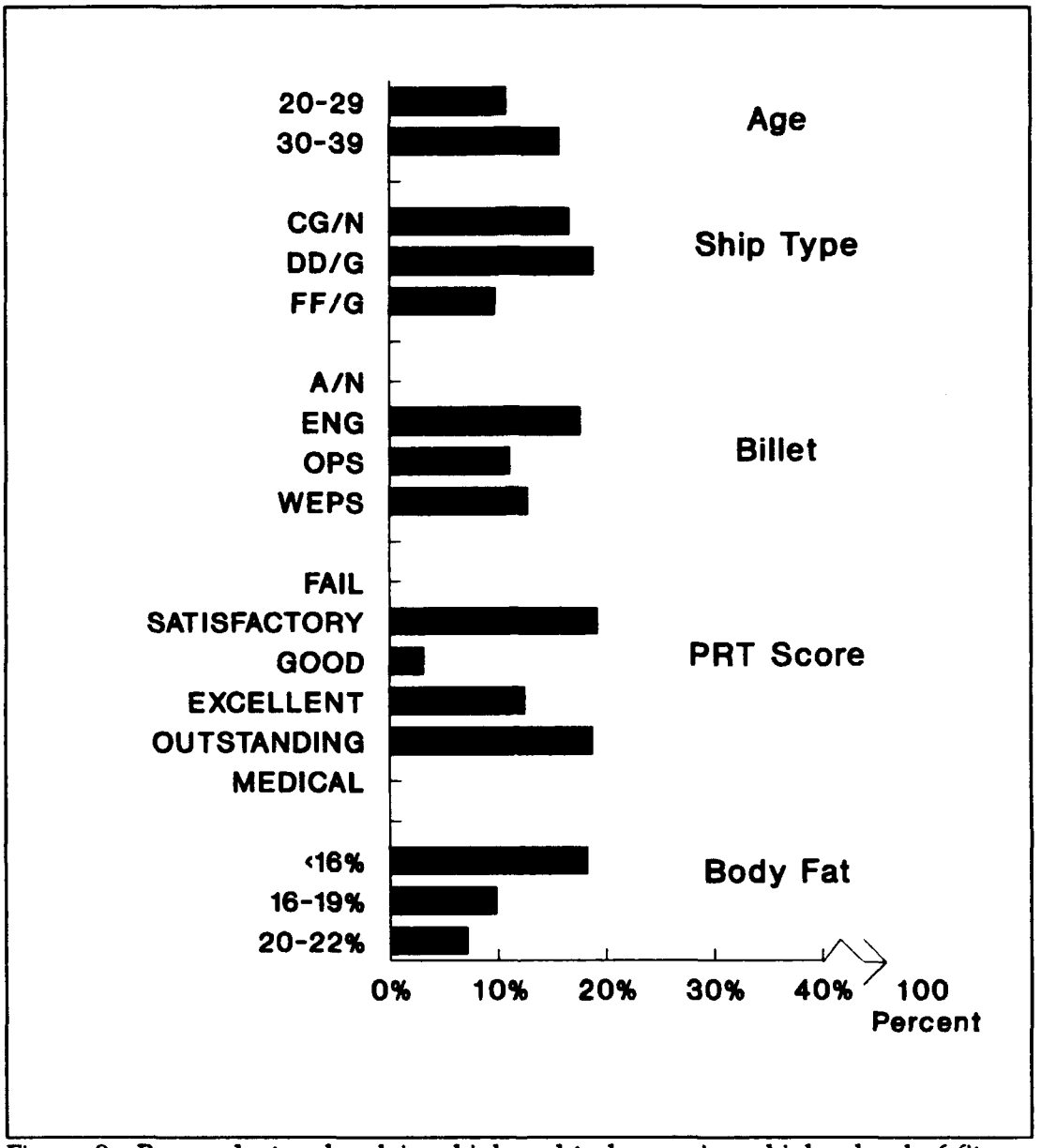

Figure 9. Respondents who claim shipboard tasks require a higher level of fitness than needed to pass the PRT (Source: NPS Survey)

2. Officer Survey Instrument

a. Description

The Officer Survey Instrument (OSI) was developed by the Naval Occupational Development Analysis Center (NODAC) and approved for release in July of

1988. The survey was modeled by NODAC after a civilian questionnaire, the Professional Managerial Position Questionnaire, and was designed to gather information concerning the respondents' billet, personal/job background, managerial and professional responsibilities, and leadership [Ref. 19]. The survey was mailed to 10,000 naval officers, including officers in every rank from each community. Personnel who were in a training or transient status were excluded from the survey. In December 1988, after 7,381 surveys were collected and entered into the OSI data base, the survey was considered closed.

b. Respondents

Despite a wide variety of officer types responding to the survey, only surface warfare officers (designators 1110 and 1115) and potential surface warfare officers (designators 1160 and 1165) were examined for this portion of the present study. The field of respondents was further narrowed to include only those individuals whose job title reflected a shipboard job. The final data pool for this thesis consisted of 110 respondents.

Although this survey furnished no method of separating the respondents by gender or ship type, information provided by the respondents did allow for categorization by billet type. The distribution is as follows: administration/navigation, 11.8 percent; weapons, 25.5 percent; operations, 24.5 percent; and engineering, 38.2 percent.

This survey primarily dealt with issues concerning leadership and management; however, several questions focused on physical readiness testing and training (See Appendix D). The responses to these particular questions were isolated, and are summarized as follows.

c. Results

Those participating in the survey were asked, "Does your job demand a higher level of physical fitness than that required to meet the 'satisfactory' performance

level on the semi-annual physical readiness test (PRT)?". Approximately one-eighth of the data pool members (12.8 percent) responded "yes" to this question. The remaining 87.2 percent answered "no." (See Figure 10).

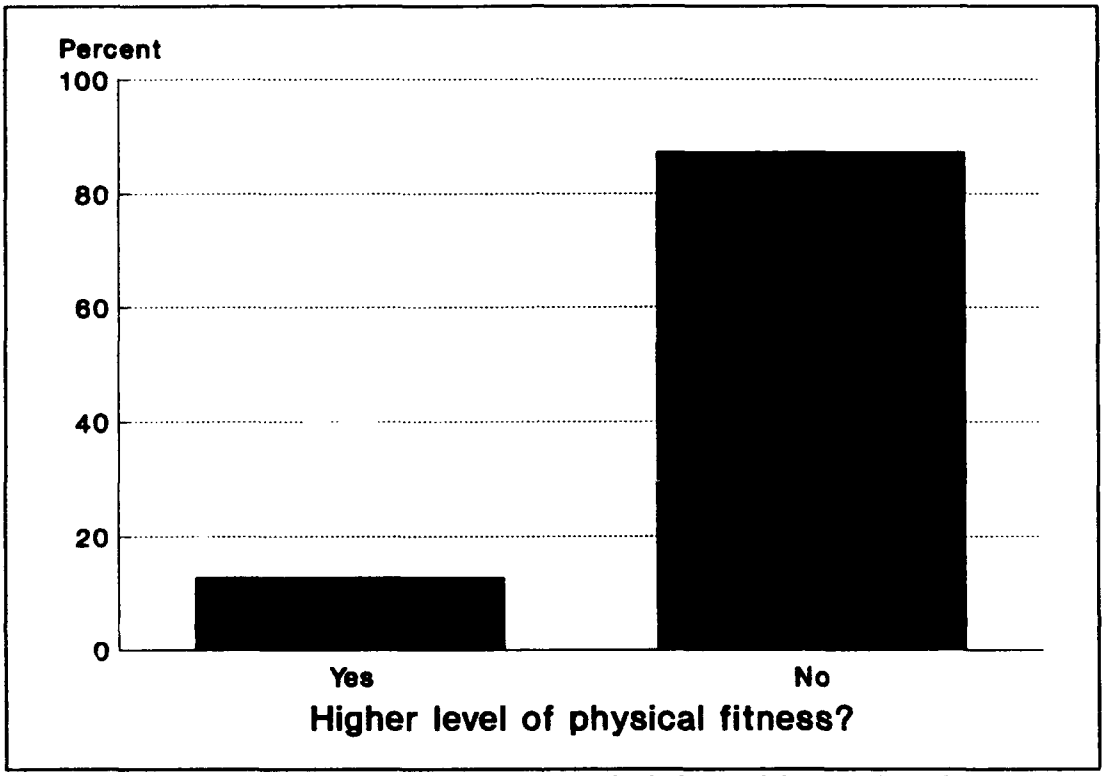

Figure 10. Does your job demand a higher level of physical fitness than that required to meet the 'satisfactory' performance level on the semi-annual physical readiness test? (Source: Officer Survey Instrument)

Respondents also reported the scores they obtained on their most recent, official PRT. None of the individuals in the data pool claimed to have failed the PRT or to have been medically excused from it. The largest percentage of respondents (38.5 percent) scored excellent, and another 29.4 percent scored outstanding. Scores of good and satisfactory were reported by 17.4 percent and 14.7 percent, respectively. Figure 11 illustrates the distribution of PRT scores.

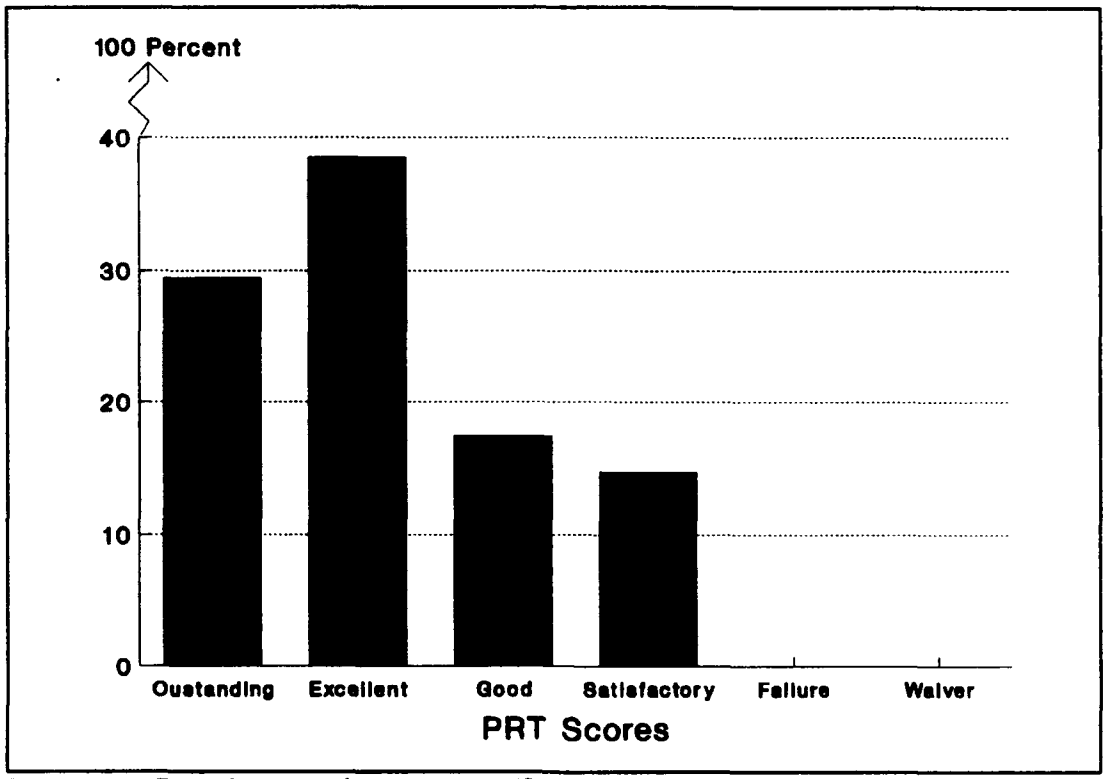

Figure 11. Distribution of PRT scores (Source: Officer Survey Instrument)

The remaining portion of the survey focused on exercise opportunities and habits. Participants were asked whether or not command policy provided time during the workday to exercise. Over 40 percent answered "no" to this question. (See Figure 12).

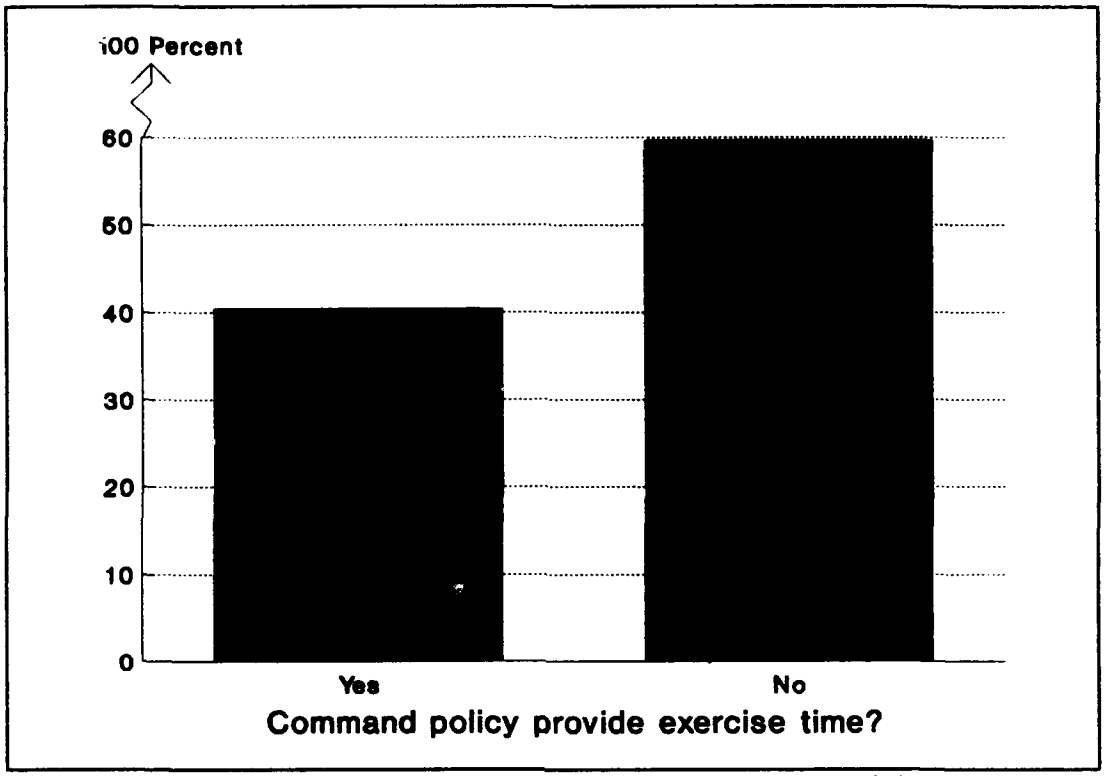

Figure 12. Does command policy provide time during the workday to exercise? (Source: Officer Survey Instrument)

A similar question concerned the time and opportunity to exercise in addition to performance of work duties. Respondents were allowed to choose from answers which ranged from "absolutely never enough" to "always enough." Results from this question are as follows: absolutely never enough, 17.3 percent; generally never enough, 30.0 percent; mixed (about 50/50), 28.2 percent; often enough, 8.2 percent; generally enough, 10.0 percent; always enough, 6.4 percent. (See Figure 13).

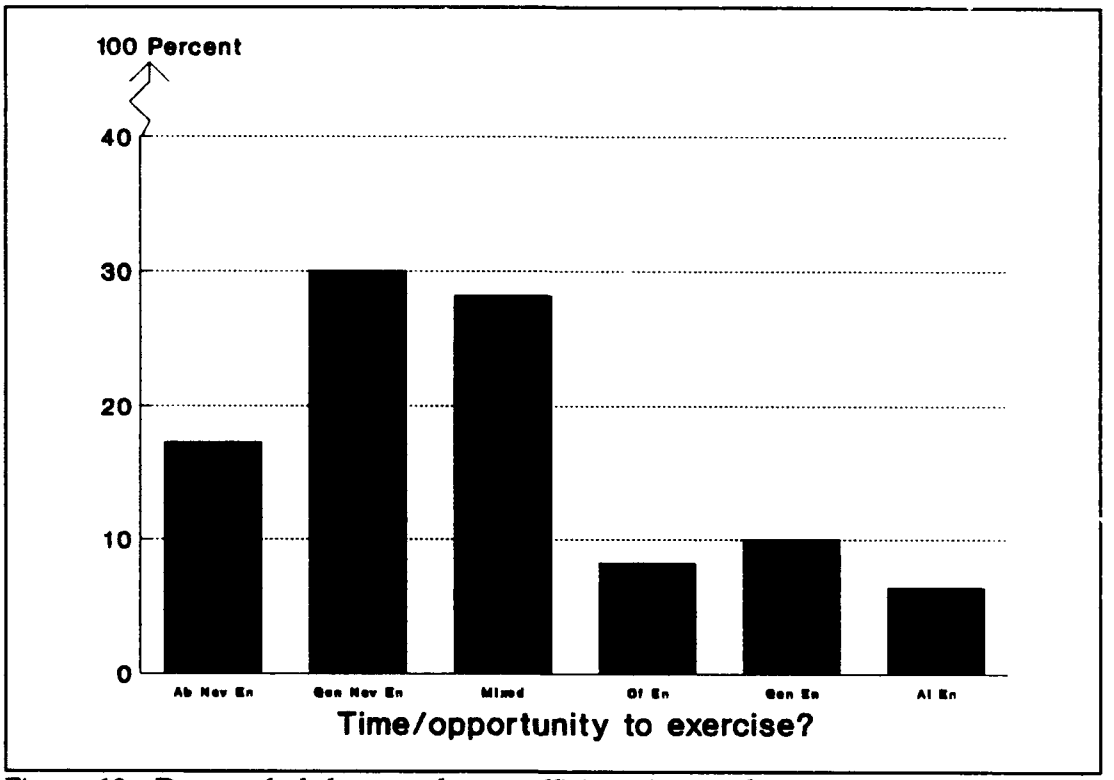

Figure 13. Do you feel that you have sufficient time and opportunity to exercise in addition to performing your work duties? (Source: Officer Survey Instrument)

The final question pinpointed the actual number of hours per week that survey respondents participated in vigorous exercise designed to promote cardiovascular fitness. Two separate categories were included in this question: hours on duty and hours off duty. Nearly 60 percent indicated that they did not exercise at all during working hours, but only 5.6 percent claimed they did not participate in cardiovascular exercise while off duty. The proportion of individuals who exercised between one and five hours during the work day was 36.4 percent (64.9 percent, off duty), and between six and ten hours was 3.0 percent (21.4 percent, off duty). Only 1.0 percent claimed they exercised more than ten hours during working hours, while 8.3 percent reported an excess of ten hours of exercise off duty. (See Figure 14).

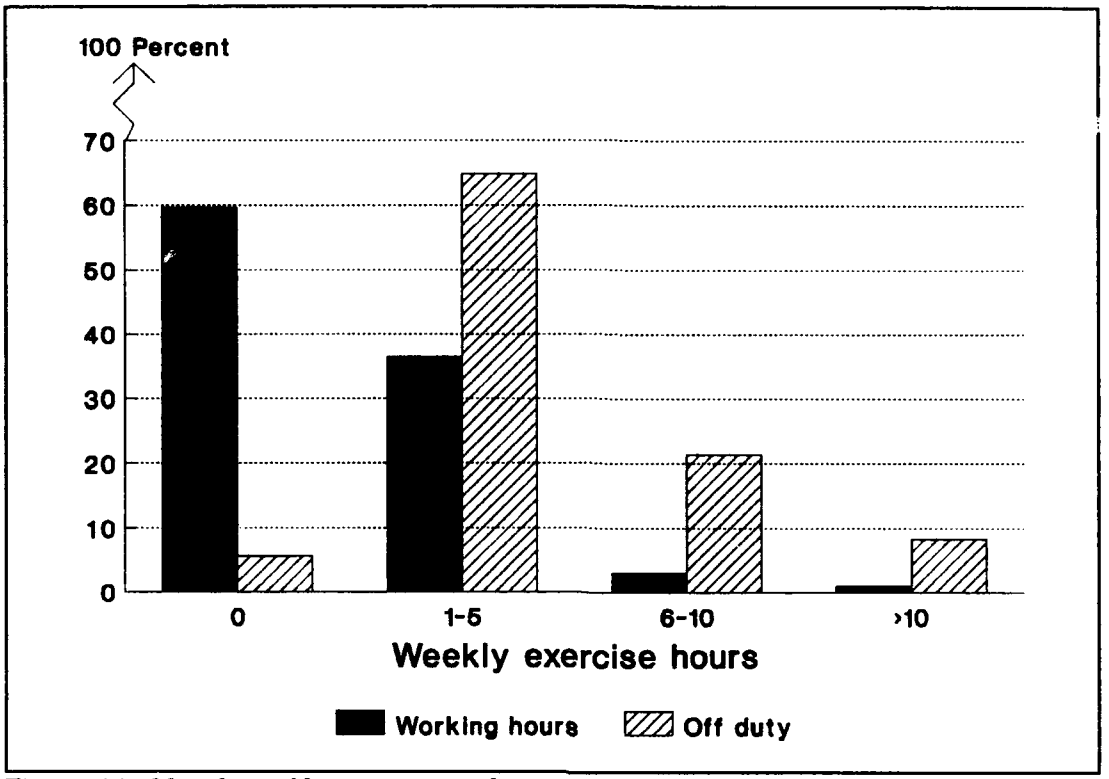

Figure 14. Number of hours per week spend in vigorous physical exercise designed to improve cardiovascular fitness (Source: Officer Instrument)

Frequency analyses, similar to the NPS survey, were performed on those data by the author of the present effort. Once again, analyses focused on the issue of job and PRT fitness demands. Those individuals who responded "yes" to the question, "Does your job demand a higher level of physical fitness than that required to meet the 'satisfactory' performance on the semi-annual physical readiness test?," were isolated (14 of 110 people). The results of this analysis are summarized as follows.

Do individuals who have a particular characteristic, e.g., an outstanding PRT score, tend to answer "yes" to this question to a greater or lesser extent than their counterparts? Survey results showed that 18.8 percent (6 of 32 respondents), 11.9 percent (5 of 42 respondents), 5.3 percent (1 of 19 respondents), and 6.3 percent (1 of 16

respondents) of individuals in the outstanding, excellent, good, and satisfactory categories, respectively, did indeed answer "yes" to the fitness question.

Individuals who answered "yes" and those who answered "no" to the question, "Does command policy provide time during the workday to exercise?," were also examined. It was found that 13.6 percent of the "yes" responses (8 of 65 respondents) and 12.3 percent of the "no" responses (6 of 44 respondents) felt their job did demand a higher level of fitness than that required to score satisfactory on the PRT.

A similar question concerned sufficient time and opportunity to exercise in addition to work duties. What proportion of respondents felt their job demanded a higher level of fitness? Those who answered "absolutely never enough," 15.8 percent (3 of 19 respondents); "generally never enough," 15.2 percent (5 of 33 respondents); "mixed (about 50/50)," 12.9 percent (4 of 31 respondents); "often enough," 11.1 percent (1 of 9 respondents); "generally enough," 9.1 percent (1 of 11 respondents); and "always enough," 0.0 percent (0 of 7 respondents).

The final question concerned the number of hours per week the respondents engaged in vigorous aerobic activity. Of those who reported zero hours during work, and those who reported zero hours away from work, 15.3 percent (9 of 59 respondents) and 16.7 percent (1 of 6 respondents), respectively, believed their job demanded a higher level of fitness than required to score satisfactory. Another 11.1 percent (4 of 36 respondents) and 14.3 percent (10 of 70 respondents), claiming one to five hours of aerobic exercise (during work and away from work, respectively), shared similar feelings about the fitness issue. Finally, 8.7 percent of individuals (2 of 23 respondents) who exercised from six to ten hours per week (away from work), responded "yes" to the fitness question. The categories of six to ten hours (during work), greater than ten hours

(during work), and greater than ten hours (away from work) were omitted from the frequency analysis due to a low number of responses. The results are summarized in Figure 15.

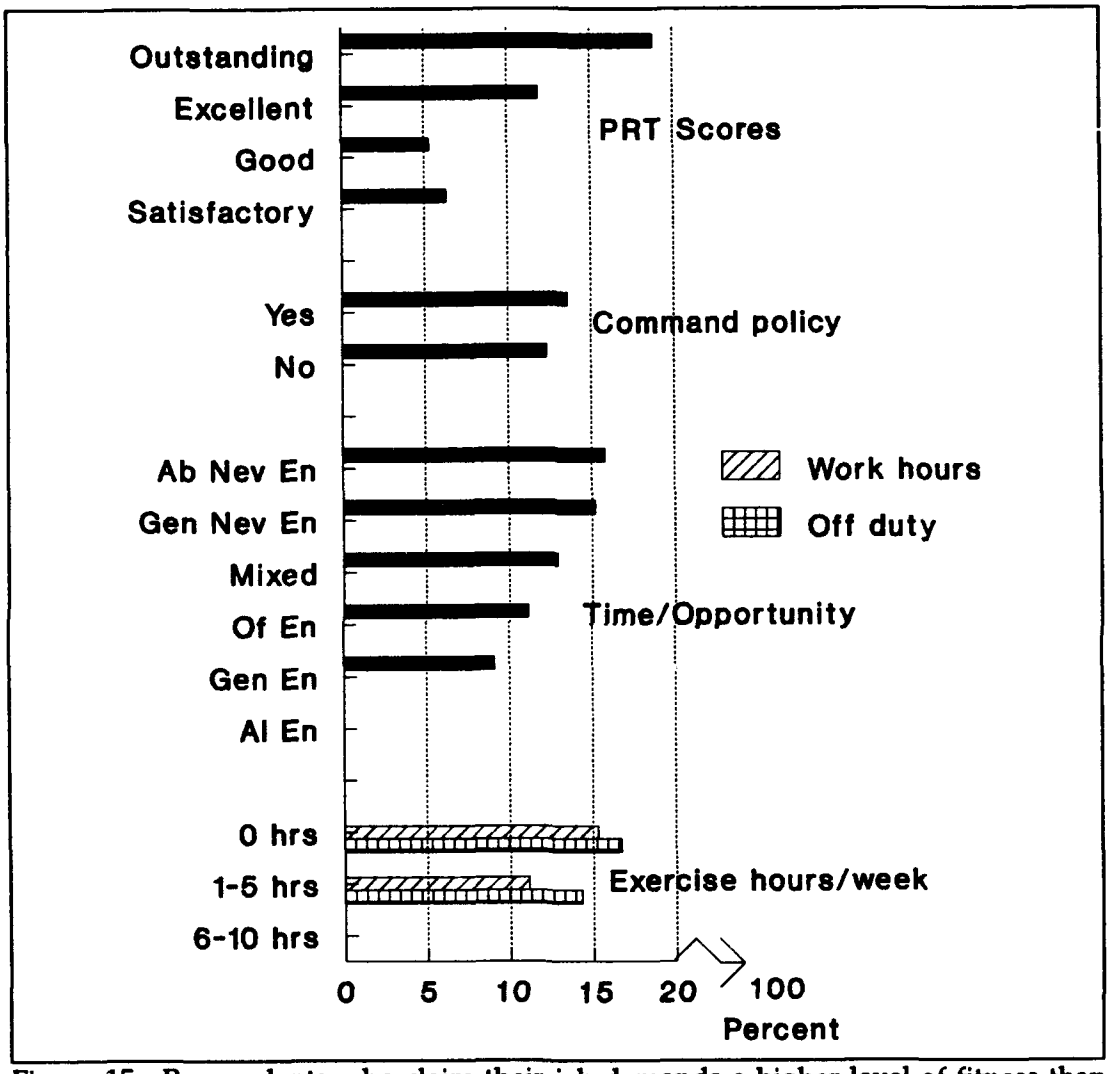

Figure 15. Respondents who claim their job demands a higher level of fitness than required to score 'satisfactory' on the PRT (Source: Officer Survey Instrument)

3. Discussion

What can be learned from the results of these two surveys? Do they show similar results in the questions which are common to both? A closer examination and comparison of the results from the NPS survey and the Officer Survey Instrument follows.

a. Physical Fitness and Shipboard Tasks

Although the NPS survey and the Officer Survey Instrument were developed for different purposes, information in the OSI concerning physical fitness was applicable to this study. The data from this survey were manipulated to reflect only those responses from SWOs who were assigned to a ship at the time of the survey. At the heart of both surveys was the question which concerned adequacy of the PRT in the face of job tasks. It was found that nearly identical percentages of respondents from each survey indicated that their job demanded a higher level of fitness than necessary to meet the minimum standards required to pass the PRT. These results are summarized in Figure 16.

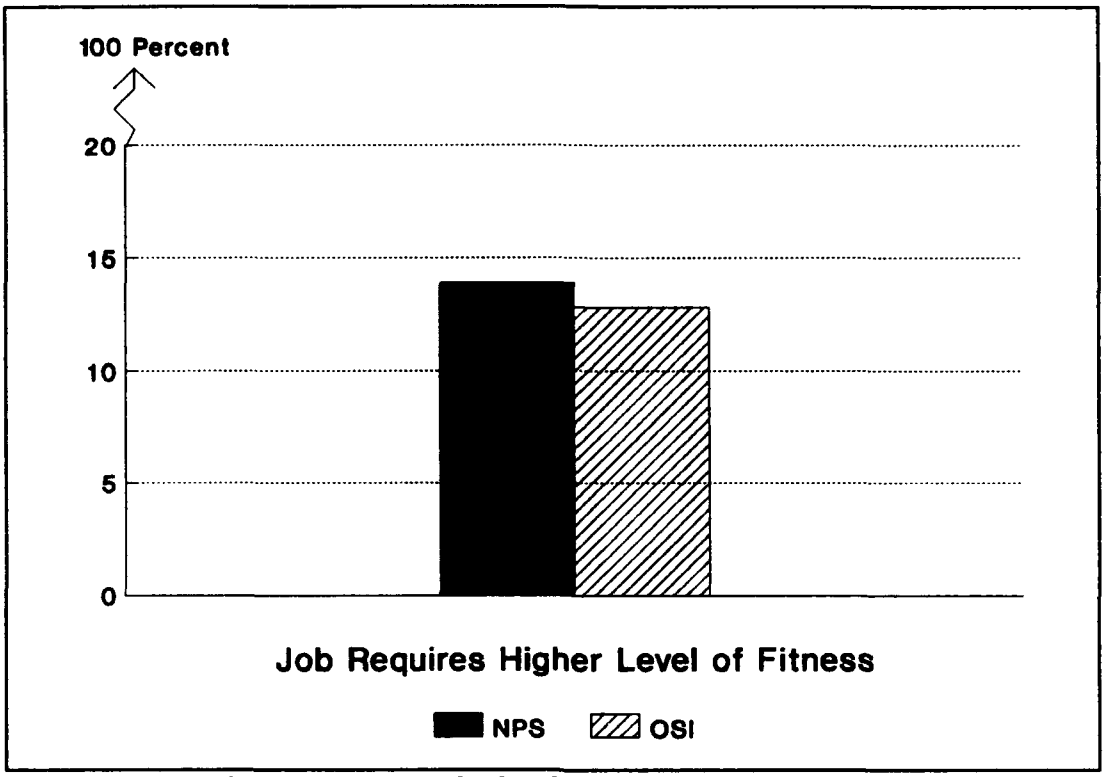

Figure 16. Do job tasks require a higher level of fitness than necessary to meet the minimum requirements to pass the PRT? (Sources: NPS Survey, Officer Survey Instrument)

To better understand the results, it is important to examine more closely the types of individuals who responded to the survey. An assessment of the characteristics of the respondents follows.

b. Age and Gender Distribution

The Naval Postgraduate School allows military officers to attend graduate school on a full-time basis to earn a master's degree and subspecialty code, in exchange for service obligation. Although members of all services attend this school, the vast majority of the officers are in the Navy. Most individuals chosen to attend NPS are junior and middle-grade officers, mostly lieutenants and lieutenant commanders.

The very nature of NPS produces bias within the survey results from this school. Evidence of this can be seen in the age-group distribution. Although surface warfare officers range in age from about 23 years old to 50 or more, the NPS survey has captured a relatively young section of the community. None of the respondents were 40 years or older. What is the importance of the disproportionate number of younger individuals within the NPS survey?

The latter part of the twentieth century has witnessed an upsurge in the pursuit of physical fitness. Research and testing in this field have brought about continual changes and adjustments in America's perception of fitness. Today's young adults have grown up surrounded by high technology exercise equipment and health food bars. Their views of what constitutes exercise and fitness may differ from the views of their parents. Thus, surface warfare officers in their 20s and 30s may approach physical fitness in a manner which is quite different from their older peers. The opinions expressed in the NPS survey may not accurately reflect those drawn from a more representative sample.

Age distribution was not achieved within the Officer Survey Instrument. However, due to the nationwide distribution of the survey, it is assumed that the ages of the respondents are distributed in a manner which more closely resembles the actual surface warfare population. Therefore, the answers are much less likely to be affected by an inherent age bias.

The NPS survey allowed the respondents to indicate whether they were male or female. Because only two of the 179 respondents were female, the results of the survey were essentially "male oriented." However, because the Officer Survey Instrument did not ask the gender of the respondents, no distinction of "male bias" can be made between the two surveys.

c. *Billet Distribution*

The nature of the billet a surface warfare officer fills may influence his or her opinion concerning shipboard demands and physical fitness. Engineering billets typically result in long hours spent in hot, cramped spaces. Compare this to the less confining (and sometimes air-conditioned) environment of the other billets, and it becomes obvious that the views of SWOs may be determined by the billets in which they serve. Although there were differences between the surveys concerning billet types, the overall distribution in the NPS survey and the Officer Survey Instrument appear somewhat similar. Both indicate that the largest percentage of surface warfare officers serve in engineering billets. A summary of these distributions is found in Figure 17.

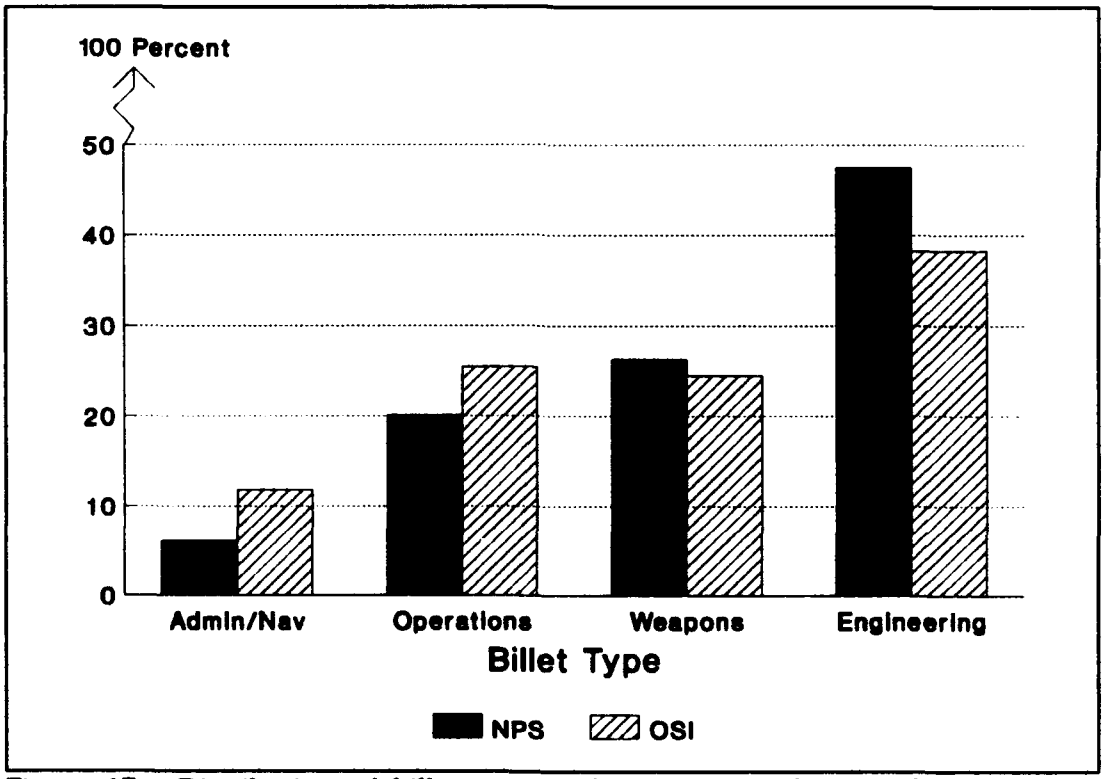

Figure 17. Distribution of billet types (Source: NPS Survey, Officer Survey Instrument)

d. PRT results

How well do surface warfare officers perform in the PRT when they are assigned to a ship? Information was collected by both surveys concerning the latest PRT score. In an effort to capture the status of the NPS respondents when they were on ship, instructions asked these respondents to report their most recent "shipboard" PRT score. A comparison of PRT score distribution is summarized in Figure 18. It is important to note that neither survey included any individuals who failed the PRT, and the NPS survey had only one respondent who reported a medical waiver from the PRT. Information from Lieutenant Commander E. J. Marcinik, Physical Readiness Program Officer at Naval Military Personnel Command (NMPC) 601E, concerning the percentage of failing scores and medical waivers of *all* 1988 Navy members is also incorporated into this Figure 18 [Ref. 20].

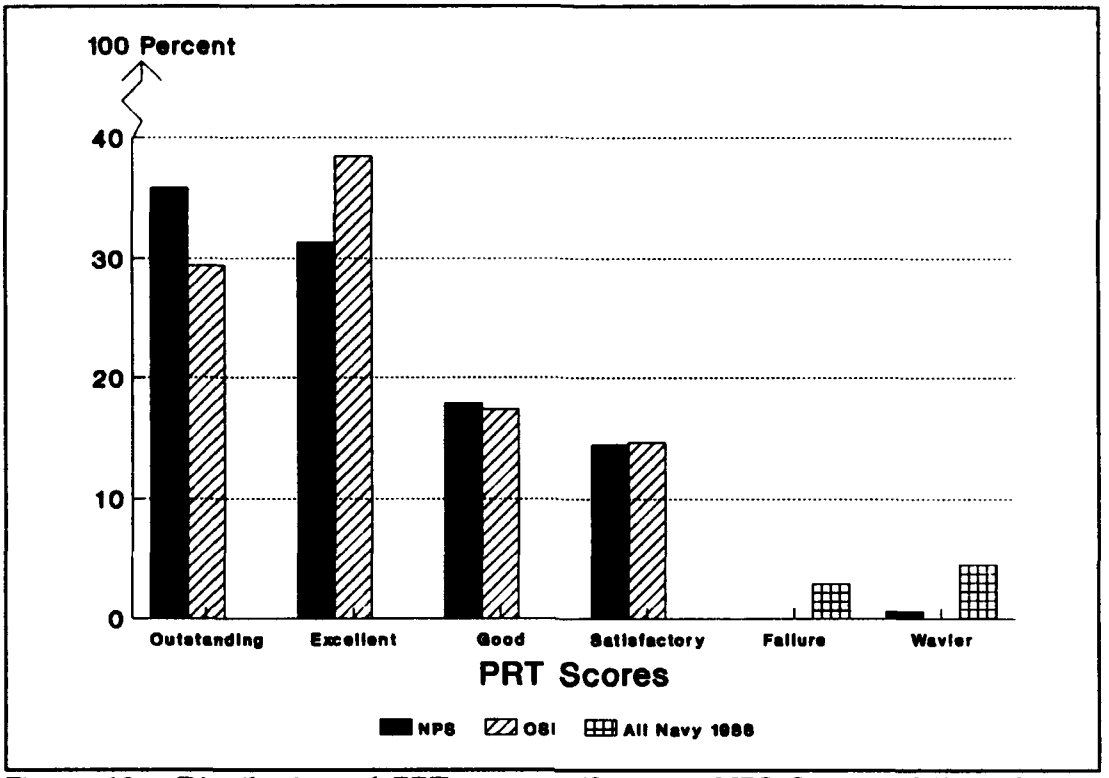

Figure 18. Distribution of PRT scores (Source: NPS Survey, Officer Survey Instrument, PRT summary survey)

Why were there no PRT failures reported in either survey? Are surface warfare officers more physically fit and better able to meet PRT standards than their Navy peers in other communities? This may be the case, but perhaps the stigma of failure biased the survey. Despite anonymity within the survey, those who did not pass may have been reluctant to respond. It is also important to note that the number of failures and medical waivers throughout the Navy was low. Because the sample sizes of the two surveys were relatively small, the number of respondents reporting failure or medical waiver may not accurately reflect the true distribution throughout the surface warfare officer community. Finally, because individuals who attend NPS are screened, failure in the PRT may preclude their acceptance into the school.

e. Body fat distribution

The role that body fat plays in the perception of physical fitness/job task requirement is questionable. Do leaner individuals view the physical tasks as easier or more difficult than their counterparts? Robertson suggests that strength appears to be correlated with the weight (and body fat content) of an individual [Ref. 21]. However, excess body fat is believed to increase the level of fatigue experienced during physical activity [Ref. 22].

Almost three-fourths of the individuals who responded to the NPS survey claimed to have less than 20 percent body fat. Less than three percent of the total number of respondents could be classified as either overfat or obese. Once again, the distribution within the survey and the small sample size may have produced biased results if these numbers do not accurately reflect the body fat distribution within the entire surface warfare community. Their answers to the NPS survey questions may exhibit a "lean" bias.

f. Summary

The results of the surveys indicate that most surface warfare officers believe the Navy physical readiness test supports their job tasks aboard ship. Furthermore, despite the possibilities of bias among the surveys, particularly in the NPS survey, the percentages of respondents (in each survey) who supported this belief were nearly identical. However, it is important to note that many of the survey numbers are extremely small, and thus limit the confidence one may place in them to draw conclusions concerning these surveys.

C. PHYSICAL TRAINING OF SURFACE WARFARE OFFICERS

To better grasp the physical fitness concept, it is important to understand the role that physical training plays. Greenberg and Pargman report that proper physical training involves exercise periods of 30 minutes or longer, being performed three to four times per week, over an extended period of time [Ref. 22]. The importance of training is emphasized by these authors, who claim that training:

- should result in a level of personal fitness associated with good health
- results in increased ability of the cardiorespiratory system to distribute oxygen throughout the body
-increases the size of the heart and the efficacy of nerve impulse transmission
- results in muscle fiber thickening
- may affect psychological and emotional as well as physical status

One must examine the environment in which surface warfare officers operate, and their ability to train, before he or she can fully appreciate the physical fitness level of these men and women, and their attitudes toward fitness. What physical training facilities are available to them on ship? Do they have sufficient time during the day to exercise? Does their command support a fitness program? Answers to these types of questions provide insight into the status of SWO physical fitness.

Much of the exercise that takes place on ships, particularly during deployments, relates to the availability of specific exercise equipment. Marcinik, Hodgdon, and O'Brien studied the facilities on 20 U.S. Navy vessels (14 different ship types) homeported in San Diego, California [Ref. 23]. They found that only 15 percent of the vessels possessed

aerobic equipment (two ships had stationary bicycles, and one ship had a treadmill). Instead, the majority of vessels possessed training equipment which emphasized strength. Only 15 percent of the ships did not have any type of weight-lifting equipment on board. The other 85 percent maintained either free weights, single station weight machines, multi station weight machines, or some combination of these. All ships possessed some form of sports equipment.

The lack of aerobic conditioning equipment is important. Stone maintains, "From the fitness standpoint, aerobic power or cardiorespiratory endurance is considered the most important component of fitness" [Ref. 24:p. 18]. This concept is supported by Miller, who claims that, "Cardiovascular fitness is now recognized as the most important parameter of fitness." "People die of heart attacks," he writes, "not bicep attacks" [Ref. 25:p. 29]. The results of the shipboard facility study indicated that no vessels had well established shipboard aerobic fitness programs for all crew members. The authors report,

> The scarcity of aerobic based programs in the fleet attests to several inherent shipboard limitations. Limited space availability precludes running on many of the smaller class of ships. Where conditions for running exist, obstacles such as narrow passageways and shipboard fixtures, (i.e. opening doors and hatches) may present real safety hazards. Adverse weather conditions may also prevent or at least discourage participation in regular aerobic workouts while underway. Factors such as these lower the effectiveness and reduce the likelihood of establishing programs for cardiovascular health [Ref. 23:p. 4].

The importance of command support of physical fitness programs plays an integral role in the training opportunity of surface warfare officers. Marcinik, Hodgdon, and O'Brien claim the absence of command-sponsored fitness programs (no organized aerobic

or strength conditioning programs were found on any of the vessels surveyed) placed the responsibility of maintaining fitness on the individual crew member [Ref. 23].

The issue of command support is also addressed by the Officer Survey Instrument. About 40 percent of the surface warfare officers examined in this survey reported that command policy did not provide time during the workday to exercise. Furthermore, 47.3 percent of the respondents who answered the question, "Do you feel that you have sufficient time and opportunity to exercise in addition to performing your work duties?" answered "absolutely never enough" (17.3 percent) or "generally never enough" (30.0 percent). Finally, 59.6 percent of the respondents reported that they spent zero hours per week (during work hours) in vigorous physical exercise designed to improve cardiovascular fitness.

This information appears to indicate that physical fitness of surface warfare officers is a low priority of both the ships on which they serve and among the individuals themselves due to the established daily routine. This appears unimportant when one considers that their daily routines on board ship may not require a high level of fitness. However, in emergency or crisis situations, when ship and crew survival become the number one priority, the "insignificant" suddenly may become a matter of life and death. Physical fitness among surface warfare officers is essential.

III. FITNESS TESTING IN OFFICER ACCESSION PROGRAMS

The surface Navy has long been known for the rigorous demands it places upon its members. Physical exhaustion is frequently brought about through stressful drills, inspections, long hours of watchstanding, and the daily grind of shipboard routine. Preparation for these hardships must begin early in one's career.

Surface warfare officers enter the Navy through three primary accession points: the United States Naval Academy (USNA), Naval Reserve Officer Training Corps (NROTC), and Officer Candidate School (OCS). The first two sources provide college education to midshipmen in addition to preparing them for naval careers through professional development courses. However, OCS accepts only those individuals who already have a college degree, and instead focuses solely on the professional development aspect. Nevertheless, each source is also responsible for ensuring that potential officers are physically capable of meeting the requirements imposed by the naval mission. Like their fleet counterpart, these accession sources must gauge the physical fitness level of their members through various testing and measurement procedures. This chapter describes the physical fitness tests required by each accession source and presents the minimum standards for test components and body fat measurements necessary to receive a commission as a naval officer. These accession standards are compared with fleet PRT requirements to establish differences between the programs.

A. UNITED STATES NAVAL ACADEMY

The greatest difference between the physical standards supported by the fleet PRT and those upheld in officer training can be found at the United States Naval Academy, located in Annapolis, Maryland. The Academy graduates approximately one-thousand midshipmen annually, and each midshipman must meet specific physical requirements to receive a commission into the military.

As part of the four years of physical education classes (161 class hours), each prospective officer must pass the physical fitness test as prescribed by the Academy. Eight hours are dedicated each year to the administration of the test. The physical fitness test consists of three components: the one-mile run, the applied strength test (AST), and the obstacle course. All students are graded on a numerical scale of zero to 100, (A to F) in each event, except for the obstacle course, which is a pass/fail item. Descriptions and requirements for each event are outlined as follows [Ref 26].

1. The One-Mile Run

The one-mile run, designed to test cardiovascular fitness, is administered to all midshipmen. The maximum times allowed for men and women to receive a passing grade (60 percent or D) are 6 minutes and 30 seconds and 7 minutes and 30 seconds, respectively. This requirement remains the same throughout each of the four years spent at the Academy.

2. The Applied Strength Test

The applied strength test was developed to measure muscular strength and endurance of the upper and lower body and the abdominal region. This test consists of three separate events: sit-ups, the standing long jump, and pull-ups (men) or the flexed arm hang (women). Requirements for each event become increasingly more difficult as the

midshipmen progress from the fourth class (freshman) year through the first class (senior) year. Minimum requirements for each event are summarized below in Table 1.

TABLE 1. APPLIED STRENGTH TEST REQUIREMENTS AT USNA.

A. Sit-ups (2 minutes)

	Women	Men
4/C	53	58
3/C	54	59
2/C	55	60
1/C	56	61

B. Standing long jump (inches)

	Women	Men
4/C	60	72
3/C	61	73
2/C	62	74
1/C	63	75

C. Flexed arm hang (seconds) (women)

4/C	13
3/C	15
2/C	18
1/C	20

Pull-ups (men)

3
4
5
6

(Source: United States Naval Academy)

3. The Obstacle Course

The obstacle course is used to measure midshipman agility, strength, speed, and "physical courage," or the ability to push one's self beyond his or her physical limits. It consists of a 440-yard course equipped with 13 obstacles. This test, administered on a pass/fail basis, must be completed by men and women in 2 minutes and 55 seconds and 3 minutes and 40 seconds, respectively. Like the one-mile run, this requirement is the same for midshipmen throughout their career at the Academy.

4. Body Fat/Weight Standards

Upon entrance into the Naval Academy, male midshipmen must have a body fat content which does not exceed 26 percent. The maximum body fat content for female midshipmen is 36 percent. However, to receive their commission from this source, the body fat level of men and women must be no greater than 22 percent and 26 percent, respectively.

B. NAVAL RESERVE OFFICER TRAINING CORPS

Individuals who do not attend the Academy may pursue a commission through one of 66 NROTC units across the United States. However, physical requirements for this commissioning source are quite different from those previously mentioned. Prior to 1990, CNETINST 1533.12D required Navy Option midshipmen (as opposed to Marine Option midshipmen) to pass the semi-annual PRT as set forth in OPNAVINST 6110.1C [Ref. 27, 28]. As indicated by this instruction, midshipmen were required to complete and pass the sit-reach component, attain the minimum number of curl-ups and push-ups in separate two-minute periods, and complete the 1.5 mile run or 500-yard swim within the allotted amount of time. An overall grade of "satisfactory" was necessary to complete the physical requirements of the NROTC program.

Professors of Naval Science[1] (PNSs) meet on an annual basis in Pensacola, Florida to discuss the training programs at NROTC units. During the past year, these individuals expressed concerns relating to the minimum scores required to pass the NROTC physical testing standards. The PNSs believed the standards were too lenient--claiming that young

[1]Professors of Naval Science, generally Navy captains, are the commanding officers of the NROTC units.

adults in the NROTC program should be held to a higher level of fitness. These concerns led the Chief of Naval Education and Training (CNET) to promulgate Navy letter 1530 serial N-1/082 of 20 June 1990 [Ref. 29]. This document sets forth the following new physical requirements for NROTC midshipmen.

Fourth class midshipmen (freshmen) are still required to achieve a score of "satisfactory" as prescribed by OPNAVINST 6110.1D. As a condition for entry into advanced standing, third class midshipmen (sophomores) must achieve a score of "good" on the PRT by the end of the third class year. These requirements are outlined in Table 2.

TABLE 2. NROTC PHYSICAL REQUIREMENTS.

	Men	Women
Curl-ups (2 minutes)	50	45
Push-ups (2 minutes)	42	17
1.5 mile run	12:00 minutes	15:00 minutes
Body fat percentage	22	30

(Source: CNET letter 1530 serial N-1/082)

Second and first class midshipmen (juniors and seniors) must maintain this score of "good" on the semi-annual PRT. Additionally, body fat standards for male and female midshipmen reflect those set forth by OPNAVINST 6110.1D. To receive a commission, men may not exceed 22 percent body fat and women may not exceed 30 percent body fat.

C. OFFICER CANDIDATE SCHOOL

The Navy's Officer Candidate School is located at the Naval Education and Training Center in Newport, Rhode Island. This 16-week program, set forth by NAVOCSINST 6110.2D, assesses the fitness level of the officer candidates at the second, seventh, and fourteenth week, in accordance with OPNAVINST 6110.1D [Ref. 30]. The first test is simply used to evaluate the fitness level of officer candidates, and to determine which individuals require remedial physical training. The second and most stringent assessment occurs when the officer candidates are approximately half-way through the program. At this point, all officer candidates are expected to perform curl-ups, push-ups, and the 1.5 mile-run according to the standards listed in Table 3.

TABLE 3. OCS WEEK 7 PHYSICAL REQUIREMENTS.

	Men	Women
Curl-ups (2 minutes)	55	50
Push-ups (2 minutes)	45	20
1.5 mile run	11:30 minutes	14:00 minutes
Body fat percentage	22	30

(Source: NAVOCSINST 6110.2D)

To graduate from OCS and receive a commission, officer candidates must pass a slightly less difficult test during the fourteenth week. The requirements are the same as those listed in Table 2, except female officer candidates must complete the run in 14

minutes and 30 seconds rather than in 15 minutes. Body fat standards, 22 percent for men and 30 percent for women, are the same as those set forth by OPNAVINST 6110.1D.

D. FLEET REQUIREMENTS

Once an individual has received a Navy commission, he or she will adhere to a different set of physical fitness requirements. Although a high level of fitness is still encouraged in the fleet Navy, the minimum requirements are somewhat less than those of the accession points. Table 4 illustrates the minimum standards required for a 20- to 29-year-old officer to score a "satisfactory" or pass the fleet PRT.

TABLE 4. "SATISFACTORY" REQUIREMENTS FOR THE PRT, AGE GROUP 20-29 YEARS OLD.

	Men	Women
Curl-ups (2 minutes)	40	33
Push-ups (2 minutes)	29	11
1.5 mile run	13:45 minutes	16:45 minutes
Body fat percentage	22	30

(Source: OPNAVINST 6110.1D)

E. REQUIREMENT DIFFERENCES

Each of the three accession points measures abdominal strength and endurance in the same fashion as in the fleet--performing as many curl-ups as possible in a two-minute time period. However, the number required within the two minutes ranges from 40 for men and 33 for women (fleet requirement) to 61 for men and 56 for women (USNA). The

requirements for NROTC units and OCS fall in the middle of this range, with 50 and 45 curl-ups for men and women, respectively.

Upper-body strength and endurance is measured in the fleet, at OCS, and at NROTC units by requiring the members to perform as many push-ups as possible within a two-minute period. To receive a commission from OCS or a NROTC unit, a man must perform 42 push-ups and a woman must perform 17 push-ups. A 20- to 29-year-old man in the fleet must perform 29, while a female in the same age bracket must perform 11. The Naval Academy measures upper-body strength and endurance in a different manner. As part of the applied strength test, male midshipmen must be able to perform a minimum of six pull-ups to receive a commission from this source. Their female counterparts are required to perform the flexed arm hang for at least 20 seconds.

The fleet, in an effort to assess flexibility, requires its members to touch their fingers to their toes in a sitting, straight leg position. Individuals at NROTC units are required to perform the same maneuver in accordance with *OPNAVINST 6110.1D*. The Naval Academy and OCS, however, have no direct measure of flexibility included in their physical testing procedures.

Aerobic capacity is measured in the fleet and at each accession source through a timed run. The fleet, OCS, and NROTC units utilize a 1.5 mile run, while the Naval Academy requires its members to run one mile. Men and women in the fleet must complete the run in 13 minutes and 45 seconds, and 16 minutes and 45 seconds, respectively (satisfactory). Requirements for men in OCS and NROTC are somewhat more stringent at 12 minutes. Likewise, women in these programs must complete the run in the time of 14 minutes (good). The Naval Academy requires its men to run one mile in 6 minutes and 30 seconds, and its women in 7 minutes and 30 seconds. It is important to

note that neither the Naval Academy nor NROTC allow their participants to perform the 500-yard swim as an alternative to the 1.5 mile run. Officer candidates can do so only with special permission from the Director of OCS.

The greatest differences in the physical assessment procedures concern two aspects of the Naval Academy's fitness test. The standing long jump is included as a measure of lower body strength, and the obstacle course is utilized to test midshipman speed, agility, strength, and "physical courage." None of the other fitness tests have a comparable event to measure these characteristics. Table 5 summarizes the various components of each organization's physical fitness test.

TABLE 5. COMPARISON OF PHYSICAL FITNESS REQUIREMENTS IN THE NAVY FLEET AT THE THREE PRIMARY COMMISSIONING SOURCES.

	FLEET	USNA	OCS	NROTC
UPPER BODY STRENGTH AND ENDURANCE	*PUSH-UPS* 2 minutes M/29 F/11	*PULL-UPS* M/6 *FLEXED HANG* F/20 secs	*PUSH-UPS* 2 minutes M/42 F/17	*PUSH-UPS* 2 minutes M/42 F/17
ABDOMINAL STRENGTH AND ENDURANCE	*CURL-UPS* 2 minutes M/40 F/33	*SIT-UPS* 2 minutes M/61 F/56	*CURL-UPS* 2 minutes M/50 F/46	*CURL-UPS* 2 minutes M/50 F/46
FLEXIBILITY	*TOE TOUCH*	*NONE*	*TOE TOUCH*	*TOE TOUCH*
AEROBIC CAPACITY	*1.5 M RUN* M/13:45 F/16:45 *500 YD SWIM* M/13:15 F/17:00	*1 M RUN* M/6:30 F/7:30	*1.5 M RUN* M/12:00 F/15:00	*1.5 M RUN* M/12:00 F/15:00
LOWER BODY STRENGTH	*NONE*	*STANDING LONG JUMP* M/75 in F/63 in	*NONE*	*NONE*
SPEED, AGILITY, PHYSICAL COURAGE	*NONE*	*OBSTACLE COURSE* M/2:55 F/3:40	*NONE*	*NONE*
BODY FAT	M/22% F/30%	M/22% F/26%	M/22% F/30%	M/22% F/30%

(Sources: United States Naval Academy, NAVOCSINST 6110.1D, CNET letter 1530 serial N-1/082, OPNAVINST 6110.1D)

F. DISCUSSION

Why do these differences exist among the three accession sources and the fleet? Mission requirements and tradition may play a role in establishing requirements. The NROTC units and the Naval Academy deal with young adults (approximately 17- to 25-years-old) as they pursue academic and military education. Because OCS provides military

education and training to college graduates, they work with an older group of individuals. However, it is important to note that NROTC and OCS physical requirements are essentially the same, and Naval Academy requirements differ significantly from both. Is it equitable to apply different physical standards to future naval officers simply because they attend a different commissioning source?

The NROTC and OCS physical requirements (needed for commissioning) are somewhat more difficult than fleet requirements (to achieve a score of "satisfactory"). Except for the curl-up portion, USNA physical requirements cannot be directly compared to fleet requirements. Nevertheless, given that the curl-up requirement is more stringent at the Academy, one can probably conclude that the upper body and aerobic standards are also more difficult at this institution than in the fleet standards. What is the reason for this difference? Should the physical requirements of accession points exceed those of the fleet?

Each of the three accession points specify a physical training program in addition to military education. Time is allotted each day or each week for physical training. Compare this opportunity to achieve and maintain physical fitness with that provided by the fleet. In many cases, job demands placed on the naval officer do not allow the individual time to participate in physical training during the work day. This places the responsibility of fitness solely on the officer, who must then exercise during off-duty hours. As the equity issue arises, the reason for the difference in fleet and accession requirements becomes more obvious. Is it really fair to hold fleet members to the same physical standards as those who are required to participate in physical training as part of their work day?

IV. EVALUATION OF THE PRT

A. BACKGROUND

In 1980, President Jimmy Carter asked the Secretary of Defense to report on the physical readiness of each branch of the military. Surprisingly, it was reported that the military was no more fit than the general public [Ref. 31]. On 29 June 1981, the Department of Defense (DOD) issued Directive 1308.1, which required the military services to adopt the following physical fitness policy:

> Physical fitness is a vital component of combat readiness and is essential to the general health and well-being of armed forces personnel. Individual service members must possess the stamina and strength to perform successfully any potential mission. These qualities, together with weight control, form the basis of the DOD physical fitness program [Ref. 32].

In an effort to execute this policy, the armed forces were required to execute the following:

> 1. Physical Fitness: Military Services shall design and implement physical fitness programs, consistent with the established principles of physical conditioning. These programs may be tailored to suit the particular needs and mission of each Service [Ref. 32].

> 2. Weight Control: designed to provide standards that enhance the attainment and retention of good health, physical fitness, and a trim military appearance. The determining factor in deciding whether a service member is overweight is the member's percent body fat. Military Services shall determine body composition and fat standards consistent with the mission of the Services. Standards shall be evaluated for consistency with health-fat relationships [Ref. 32].

The result of this directive was the development of five different methods to assess physical fitness within the armed services. The standards imposed on a typical 35-year-old male member would depend on his branch of service. For example, the Army would require him to do 38 sit-ups in two minutes, 33 push-ups in two minutes, and run two miles in 18 minutes, on a semi-annual basis. Meanwhile, if he were a sailor, he would have to perform 32 curl-ups in two minutes, 23 push-ups in two minutes, pass the sit-reach flexibility test, and complete a 1.5-mile run/walk in 15 minutes and 30 seconds (or the 500-yard swim in 15 minutes and 45 seconds). This also would take place twice a year [Ref. 33].

The Marine Corps would require the same individual to do 35 sit-ups in two minutes, and three pull-ups or chin-ups in two minutes. The 3-mile run is twice as long as that of the Navy, and must be completed in 29 minutes. Additionally, a Marine cannot achieve the minimum score in all three areas and still pass the test. He must achieve a better-than minimum score in at least one test component, or he will fail the test. The Marine Corps fitness test is also administered on a semi-annual basis [Ref. 33].

Although the other services test muscular strength and aerobic capacity, the Air Force physical fitness test emphasizes only the aerobic portion. The same 35-year-old man would be required to either run 1.5 miles in 13 minutes and 15 seconds, or walk three miles in 40 minutes and 45 seconds. This must be done once every year [Ref. 32]. The Coast Guard does not even require physical fitness testing, and instead emphasizes "comportment in uniform" [Ref. 33].

Army Lieutenant Colonel John S. O'Connor, director of training at the Army Physical Fitness School at Fort Benjamin Harrison, Indiana, attributes some of the fitness testing differences among the services to mission requirements. "In the Army and Marine Corps,

fitness is geared more to training for battle. But in the Air Force and Navy, fitness is more of a medical issue. They take a health-oriented approach" [Ref. 33:p. F11]. In addition to the physical fitness tests, the Army, Navy, and Marine Corps measure body fat percentages (the Air Force is considering adopting body fat measurements), and all four maintain height and weight standards. Table 6 summarizes the differences in the physical fitness requirements among the military services.

TABLE 6. COMPARISONS OF THE PHYSICAL REQUIREMENTS FOR A 35-YEAR-OLD MAN IN THE FOUR COMPONENTS OF THE ARMED FORCES.

	ARMY	NAVY	AF	MC•
Upper Body	33 push-ups 2 minutes	23 push-ups 2 minutes	NONE	3 pull-ups 2 minutes
Torso	38 sit-ups 2 minutes	32 curl-ups 2 minutes	NONE	35 sit-ups 2 minutes
Aerobic	2 mi run 18:00 min	1.5 mi run 15:30 min or 500 yd swim 15:45 min	1.5 mi run 13:15 min or 3 mi walk 40:45 min	3 mi run 29:00 min
Flexibility	NONE	Toe Touch	NONE	NONE

• Marine Corps personnel can pass all three tests with the minimum number of points and still fail overall.

(Source: Navy Times, April 22, 1991)

Despite all of these differences, this study focuses only on the Navy requirements. The physical readiness test is examined closely. The assessment includes an analysis of each component that comprises the PRT, and addresses problems in the administration of the test, specifically, deployment difficulties, medical waivers, and attitudes of Navy members concerning the PRT.

B. PHYSICAL FITNESS

To begin assessment of the Navy physical readiness test, one must first understand the concept of physical fitness. Webb and Pagani describe physical fitness as "the ability of each person to carry out the daily tasks of the service with vigor and alertness, without injury or undue fatigue, and with ample energy to meet unforseen emergencies" [Ref 8:p. 95]. Consolazio, Johnson, and Pecora refer to physical fitness as "a quantitative expression of the physical condition of an individual" [Ref. 34:p. 340]. This concept is more specifically defined by Falls as a combination of performance in four areas: cardiovascular capacity, body composition, strength, and flexibility [Ref. 35]. Finally, Sharkey groups three of these components, (flexibility, cardiovascular capacity, and strength) plus endurance, into two separate categories, muscular fitness and aerobic fitness [Ref. 36]. Muscular fitness is determined by strength, endurance, and flexibility, and aerobic fitness is defined as the ability to take in, transport, and utilize oxygen.

There are a wide variety of physical fitness measures. Albrecht claims he found 94 different means of testing physical capacity [Ref. 37]. In this section, both muscular and aerobic fitness are viewed more closely, and the current PRT methods used to evaluate these areas of fitness are examined. Alternative measures of physical fitness are also explored. Additionally, body composition is defined, and current and alternative means of assessing body composition are addressed.

1. Aerobic Fitness

Aerobic fitness is measured by how efficiently an individual is able to retrieve oxygen (O_2) from the atmosphere, bring it into his or her lungs and blood, and transport it to the working muscles of the body. Specific components within the cells utilize this

oxygen to convert carbohydrates and fat into energy. This combination of oxygen intake, transportation, and utilization define aerobic fitness [Ref. 36].

Why is aerobic fitness so important? In addition to its relationship to cardiovascular health, aerobic fitness is also associated with an individual's work capacity. Once again, the conversion of fat and carbohydrates into energy must take place in the presence of oxygen. Therefore, tougher jobs require more energy and, thus, more oxygen. When energy needs are light, work performance is not strongly related to aerobic fitness. However, when energy needs are high (greater than 7.6 calories per minute), work capacity relates directly to the body's ability to produce energy aerobically [Ref. 36].

Sharkey defines work capacity as "the ability to accomplish production goals without undue fatigue and without becoming a hazard to yourself or your co-workers" [Ref.36:p. 242]. He found that those persons with higher aerobic fitness levels have distinct advantages over their less fit counterparts when engaged in physical activity for eight hours or more. **Highly conditioned athletes** can sustain a work level that is as high as 50 percent of their initial work capacity, while those with **above-average** fitness levels can maintain 40 percent of their initial capacity. Individuals with **average** fitness can sustain about 33 percent of their initial capacity for eight hours. Lastly, people who are **not aerobically fit** can only achieve a work performance that is approximately 25 percent of their initial work capacity within the same eight-hour period [Ref 36:pp. 242-243].

There are a wide variety of tests which assess the aerobic fitness of an individual. Some are better predictors of aerobic fitness than others, and each has its own distinct advantages and disadvantages. The most common test procedures are described as follows.

a. Aerobic Fitness Tests

(1) Maximal Oxygen Uptake

The best method of assessing aerobic fitness is through *maximal oxygen uptake* (VO_2 max). This test can be conducted on either a treadmill or bicycle ergometer, but the treadmill is preferred because it yields a slightly higher VO_2 max. The subject wears an apparatus that allows him or her to breathe room (atmosphere) air through a one-way valve and exhale through a second one-way valve into a respiratory gas analyzer. The exhaled air is evaluated for oxygen and carbon dioxide content, and a flowmeter determines the amount of air ventilated through the lungs [Ref. 36, 24].

The test involves a walk or run on a treadmill that is programmed to increase 2.5 percent in grade every three minutes. In the last minute of every three minute period, oxygen uptake measures are collected. The test ends either when the uptake values no longer increase, or when the subject is unable to continue. The greatest quantity of oxygen consumed within the one-minute periods is called the maximal oxygen uptake [Ref 24].

The most common scores range from three to four liters of oxygen consumption per minute[2]. The influence of body size is eliminated by dividing the liters per minute by the weight (in kilograms) of the individual. The resulting score, converted to the units of milliliters of O_2 per kilogram per minute, allows a direct comparison of test subjects, regardless of body size [Ref 24]. Sedentary individuals may score in the low 20s, while the average college men and women will score 44 to 48 and 37 to 41, respectively.

[2]Endurance athletes have recorded scores as high as five to six liters per minute.

Highly trained male athletes are capable of scoring in the high 70s or low 80s, while their female counterparts can reach the high 60s or low 70s [Ref 24].

(2) 1.5 Mile Run

Despite the accuracy of the maximal oxygen uptake test, equipment requirements and costs, which can exceed $100,000 [Ref. 24], make it an impractical means of assessing aerobic fitness. The Navy physical readiness test instead employs the timed 1.5-mile run as its standard measure of aerobic fitness. How does this event rate as a measure of aerobic fitness? What are the advantages and disadvantages inherent to this run? Buono's study revealed a significant correlation (-0.84) between the 1.5 r. e run and maximal oxygen uptake [Ref. 38]. Stone claims the statistical correlation between the two is usually quite high, with r=-.90 [Ref.24]. This correlation is negative because, as the run time decreases, aerobic capacity (VO_2 max) increases. Greenberg and Pargman also recommend this method to measure aerobic capacity [Ref. 22]. Thus, it appears that the 1.5-mile run is a good predictor of aerobic fitness.

In addition to its predictive ability, the 1.5-mile run has a number of other advantages. The only equipment required to administer this test is a measured course and a stopwatch. Therefore, expenses are minimal, and the test can be administered to a large number of individuals at one time. Also, because running/walking is a natural evolution, little or no training is required for this event. Captain Kimberly Ritchie, Chief of military fitness at the Air Force Military Personnel Center, claims the 1.5 mile run provides the "quickest, easiest" yardstick for the Air Force to measure fitness [Ref. 39:p. 15].

However, there are some drawbacks to the 1.5-mile run. Although OPNAVINST 6110.1D encourages PRT participants to stretch and warm-up before the test, the nature of the run results in an all-out effort from the participants, with no graduation

from a lower to a higher level of activity. This type of sudden activity may result in serious injury to the participant. Also, the nature of some running courses does not allow for constant monitoring of participants. Weber reports that about five Air Force members die each year due to heart attacks, because of overexertion on the 1.5-mile run during their annual fitness test [Ref. 39]. Dr. Loren Myre, a research physiologist at the USAF School of Aerospace Medicine, feels the run is "dangerous and invalid" as a measure of fitness. He added that the run is relatively easy for members already in good condition, but it poses a risk to airmen who do not exercise regularly [Ref. 39:p. 18]. Colonel Thomas McNish, chief of flight medicine at the Air Force Surgeon General Office, concurred with this evaluation, and said that many members neglect to exercise until the fitness test, and "they can overexert themselves and meet the standards, but that's dangerous" [Ref. 39:p. 18].

(3) 500-Yard Swim

Members participating in the PRT are allowed to perform the timed 500-yard swim in lieu of the 1.5-mile run. Again, the same questions must be answered. Is this a good measure of aerobic fitness? What are its advantages and disadvantages?

Buono performed tests on two separate groups of "healthy" college students to assess the correlation between VO_2 max and swim time. He concluded that the swim time was not highly correlated (-0.32) with oxygen uptake, and rather than assessing aerobic capacity, it was a better measure of an individual's swimming skill [Ref. 38]. This idea is supported by Stone, who claims that "there has to be a reasonable amount of swimming skill to stay afloat and exercise" [Ref. 37:p. 149]. Mangi, Jokl, and Dayton similarly propose, "Since technique is important in swimming (and cycling), athletes who don't compete in these two sports should use running as the test sport" [Ref. 40:p 15].

The appropriateness of the 500-yard swim as a test of aerobic fitness is further hampered by the availability of pool facilities. Individuals qualified in life-saving techniques should also be present at such tests. Nevertheless, there are some distinct advantages of incorporating this event as part of the PRT. One of the most appealing aspects of swimming (as opposed to some other forms of aerobic exercise) is the lack of impact injury associated with it. The body is not subjected to the strain and stress of the pounding motion of running or jogging, and is instead supported in the water by its natural buoyancy.

(4) Harvard Step Test

Despite recent attention, the Harvard Step Test has been around since the 1930s, when it was originally developed by researchers at the Harvard Fatigue Laboratory [Ref. 41]. Many adaptations have been made through the years, and, today, several variations of this test exist. However, the procedures for taking the test are essentially the same. These procedures are described as follows.

A test subject stands in front of a raised platform, ranging from 18 inches to 20 inches high. When told to begin, the subject places one foot on the platform, steps up, and then places both feet on the platform. He or she then straightens the back and legs, and immediately steps down again, with the same foot that went up first. This process is repeated every two seconds at a cadence of 30 repetitions per minute. The subject continues the step process for five minutes (women step for four minutes), and at the end of this period, the individual is seated. After one minute, his or her pulse is taken for a 30-second period [Ref. 22:pp. 71-72, Ref. 33:pp. 382-384]. Older versions of the Harvard Step Test do not require any other pulse measurements. However, more recent changes have incorporated pulse recordings (for thirty seconds) beginning at one minute,

two minutes, and three minutes after completion of the stepping procedure. Using the three pulse counts, a fitness index is calculated using the following formula:

$$\text{index} = \frac{\text{duration of exercise in seconds X 100}}{\text{2 X sum of the 3 pulse counts in recovery}}$$

An index value below 55 is considered poor, between 55 and 64 is low average, 65 to 79 is average, 80 to 89 is good, and 90 and above is excellent [Ref 22:pp. 71-72].

Other variations of the Harvard Step Test are also utilized to assess aerobic fitness. Kasch and Boyer developed a three-minute version of this test, and other methods utilize different step heights or counting procedures [Ref. 42]. Nevertheless, each variation works on the same principle--aerobic fitness is measured by determining the heart's ability to recover from mild exercise [Ref. 43].

The Harvard Step Test (and its modifications) is utilized as a means of assessing aerobic fitness for a number of reasons. The test is not only easy to administer, but requires little equipment. A premeasured running course in not required, nor is the expense or special facilities associated with a swimming pool or stationary bicycle necessary. The step test can also be given to a large number of subjects at one time. Lower bench heights do not seem to discriminate against shorter individuals. (Consolazio, Johnson, and Pecora report the 20-inch step height tends to penalize short subjects, and involves some agility [Ref. 34].) Also, Sharkey claims, "Physicians approve the test because it does not place undue stress on the respiratory and circulatory systems" [Ref. 36:p. 299].

Yet, there appear to be significant disadvantages when using the step test. Most importantly, this method may not accurately reflect aerobic fitness. Stone found the statistical correlation between the step test and VO_2 max (r=.55) was much lower than

the 12-minute run (r=-.90). The step test is positively correlated with VO_2 max, because an increase in the fitness index (from the step test) indicates an increase in aerobic capacity. However, results in this area are mixed [Ref. 24]. Sharkey reports, "When properly administered, the test will give an accurate estimate of the maximal oxygen uptake, or aerobic fitness" [Ref. 35:p. 299]. Proper administration includes correct timing of steps, measurement of resting time, and pulse counts. Unfortunately, if the test is administered to more than one person at a time, each subject must take his or her own pulse. According to Sharkey, "Pulse counting errors are common among inexperienced test takers" [Ref. 36:p. 299]. Nevertheless, the Harvard Step Test appears to have merit, and Greenberg and Pargman claim that it is "as feasible as any (measure of aerobic fitness) developed" [Ref. 22:p. 70].

(5) Stationary Bicycle

The timed stationary bicycle ride offers another alternative to measure aerobic fitness. Buono conducted a study in which test subjects performed a series of four different 5-kilometer rides on a stationary bicycle [Ref. 38]. Each test ride differed in resistance, and this resistance was based on either lean body mass or total body weight of the subject. The test results indicated the highest correlation between the bicycle ride and VO_2 max (-0.78) occurred at a resistance of 0.5 kilograms resistance per 20 kilograms of body weight.

Another version of the stationary bicycle test, the YMCA Bike Test, involves pedaling (50 revolutions per minute) at three different work loads (resistances), each three minutes long [Ref. 44]. The second work load is determined by the heart rate recorded in the first stage, and the third work load is determined by the heart rate in the

second stage. The measured heart rates are then plotted on a chart to determine the fitness level.

The advantages of utilizing a timed bicycle ride in the PRT are numerous. In addition to the relatively high correlation with maximal oxygen uptake, the timed cycle test is easy to administer and requires little space. Because it is a non-weight bearing activity, it can be administered with little risk of injury, and is especially suited for individuals who are medically excused from running [Ref 38]. Finally, pedalling a stationary cycle requires little skill, and test participants can learn to operate the cycle quickly.

Yet, there are still features which detract from this event. Stationary bicycles can cost hundreds or thousands of dollars, depending on the desired attributes. Additionally, only one individual can be tested per cycle at any one time. Therefore, testing large numbers of personnel will either be very costly, or consume a great deal of time. Lastly, despite the correlation reported by Buono, stationary bicycles require a high degree of muscle specificity to operate. Non-riders may actually perform below their aerobic potential due to muscle fatigue in the cycling muscles of the legs.

b. Discussion

Choosing the best aerobic fitness assessment involves the evaluation of several factors, including fitness predictability, equipment requirements, applicability to large numbers of subjects, and safety. The choice of the most appropriate aerobic fitness measure may not guarantee that it will be the best measure. Given the constraints of time, equipment, cost, and large numbers of personnel, the Navy may be required to sacrifice some degree of test accuracy. How good are the current PRT aerobic measures?

The 1.5-mile run seems to satisfy all constraints, and, yet, given its high correlation with VO_2 max, still acts as an excellent measure of aerobic capacity. The minimal equipment requirements (a measured course and a stopwatch) ensure this test can be administered at virtually all shore commands. The major drawback to the 1.5-mile run is the safety issue. It is important to have observers available to monitor participants during all portions of the run.

The 500-yard swim does not appear to be an appropriate means of measuring aerobic capacity. Its correlation with VO_2 max is questionable, and it appears to be a function of swimming skill rather than aerobic capacity. A swimming pool is obviously required, and due to the nature of a pool, the test can be administered to only a few individuals at one time. The only advantage of this event is that it offers an alternative method of assessment for those individuals who cannot participate in the run due to medical reasons.

The use of stationary bicycles (ergometers) and step-tests are favored as alternative forms of aerobic tests by Buono, Albrecht, and Amor and Taylor [Ref. 38, 37, 45]. These offer a more appropriate option for individuals who would be medically waived from the run. Studies show the bike ride is a relatively good method in which to assess aerobic capacity, and because it is a non-weight-bearing activity, test participants who cannot run may be able to participate in this event. Furthermore, it becomes an excellent alternative when considering test administration on deployed ships. The stationary bicycle ride requires a standardized bicycle, to ensure equality among commands, but the equipment itself requires little space. The only drawback to this method is that the test can be administered to only one individual per bicycle at one time.

Due to the muscle specificity of bicycling, this method should be considered an alternative to the run only when a stationary bicycle is available for physical training.

The step-test is another possible alternative to the 1.5-mile run. Because equipment and space requirements are minimal, it could easily be administered on board ships. However, its correlation with VO_2 max is also questionable. Finally, several personnel could take the test at one time, but this would require that each take their own pulse at the specified times. The nature of self-reported results may lead to incorrect aerobic assessments.

2. Muscular Fitness

Muscular fitness, defined by strength, endurance, and flexibility, was once viewed as the essence of physical fitness [Ref. 36]. Although aerobic fitness has now supplanted muscular fitness in this role, the inclusion of this component in the physical fitness definition is extremely important. To better appreciate muscular fitness, one must first have a clear understanding of its ingredients. Descriptions of strength, endurance, and flexibility are as follows.

a. Strength

Muscular strength is defined in a variety of ways. Sharkey states it is "the maximal force that can be exerted in a single voluntary contraction" [Ref. 36:p. 4]. Similarly, strength is described as "the ability to apply maximal force with a muscle group" and "the ability to do work against resistance" [Ref. 24:p.18, Ref. 34:p. 343]. These definitions clarify what is intuitive to most people: strength is a measure of how much an individual can push, pull, lift, or carry.

Several factors influence the amount of strength present in an individual. Consolazio, Johnson, and Pecora identify muscle size, coordination and physical condition

of the muscle groups involved, and the mechanical advantage of the bones employed [Ref. 34]. The amount of testosterone, a male hormone, is also strongly linked to muscle development and strength [Ref. 36].

Strength can actually be divided into three different categories: isometric (static), isokinetic, and isotonic strength. Isometric strength is demonstrated when an individual exerts maximal force against an immovable object, whereas isokinetic strength is a measure of the maximal force output through a range of motion. Finally, isotonic strength is the maximum weight that can be lifted once [Ref. 36]. No matter how it is defined or categorized, strength is important to the physical fitness and well-being of an individual. Muscular strength results in a decreased susceptibility to injuries (particularly joint injuries) and limits fatigue when an individual is engaged in rigorous physical activity.

b. Muscular endurance

A characteristic that is frequently associated with strength is muscular endurance. However, the two characteristics are actually quite different. Whereas strength is generally a measure of one-time performance (whether static or through a range of motion), muscular endurance is the ability to persist in a repetitive, muscularly demanding task. Berger claims, "Strength is the maximum that can be done, and endurance is the ability to do continuous work" [Ref. 46:p. 240]. Due to the energy requirements of such tasks, muscle fibers utilized for endurance are different from those needed for strength. It is important not to confuse *muscular endurance* with *endurance*, which reflects the ability to engage in cardiovascular exercise for extended periods of time. Muscular endurance can be achieved within a specific muscle group without any noticeable effect on the heart and respiratory system [Ref. 36].

c. Flexibility

Perhaps the most neglected aspect of physical fitness is flexibility, which is defined as the mobility or range of motion in a joint. Flexibility is determined by the motion allowed by muscles and connective tissues surrounding a joint, and the joint design itself. Scientists have determined that flexibility is not equal in all joints in the human body, and is established primarily by the length of the muscles surrounding the joints [Ref. 47].

Flexibility is an important piece of the physical fitness picture. It plays a particularly key role in the maintenance of good health. Injuries can occur if a limb is pushed beyond its normal range, and flexibility reduces this potential. Lack of flexibility is frequently associated with poor posture, and lower back problems, such as lordosis (excessive curvature of the lower back) and sciatica (a radiating pain in the thighs or buttocks) [Ref. 47, 36].

3. Measurement of Muscular Fitness

The Navy physical readiness test currently utilizes three different methods (curl-ups, push-ups, sit-reach) to assess muscular fitness. Each test component focuses on one area of the body. Curl-ups are used as a measure of abdominal muscle endurance, and push-ups serve as an indicator of upper-torso muscular endurance. The sit-reach does not measure endurance, but rather gauges the flexibility of the hip, back, and hamstrings. In this section, these three activities are evaluated, and alternative measures of predicting the same fitness aspects are discussed.

a. Curl-ups

The curl-up appears to be a widely accepted method of assessing abdominal endurance. A similar exercise, the sit-up[3], is also used for the same purpose. The proper method for performing the curl-up is described in Chapter 1. Stone, Sharkey, and Greenberg and Pargman each recommend curl-ups or sit-ups as a measure of abdominal endurance in home fitness tests [Ref. 24, 36, 22]. Mangi, Jokl, and Dayton support these methods of assessment with their claim that sit-ups *are the best* measure of abdominal endurance [Ref. 40].

However, Robertson and von Tagen claim the Marine Corps bent-leg sit-up is "not a true test of abdominal strength and endurance." In addition, they believe the sit-up is actually dangerous, and over a period of time, the repetitive pulling on vertebrae can lead to permanent back pain as a result of an improperly aligned spine [Ref. 48:p. 34]. Nevertheless, Miller's work with the University of Utah Physical Education Department would appear to justify the importance of the sit-up in the *Marine Corps* physical fitness test [Ref. 24]. He concludes, " Perhaps the greatest contribution of the sit-ups is not that is an accurate measure of torso, stomach, or back strength, but that the ability to recover from the sit-ups prior to the run is a measure of stamina" [Ref. 25:p. 28]. Little information was found concerning alternative measures of abdominal endurance.

b. Push-ups

The push-up also appears to be widely accepted as a means of assessing upper-body strength and endurance. Sharkey proposes the push-up specifically for this purpose [Ref. 36]. Pull-ups and chin-ups are also popular methods to measure upper body

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[3]Sit-ups are performed by clasping the hands behind the back of the head, and raising up to touch elbows to knees [Ref. 35].

capacity, and are recommended by Mangi, Jokl, and Dayton, and Greenberg and Pargman [Refs. 40, 22]. Is one method better than another? In their study, "Lifting and Carrying Capacities Relative to Physical Fitness Measures," Beckett and Hodgdon found the correlation between push-ups and pull-ups to be 0.82. They concluded that "push-ups and pull-ups measure similar aspects of physical capacity, namely muscular endurance" [Ref. 6:p. 30] However, Sorrell claims, "Few substitutes can be found to measure upper body strength more effectively than pull-ups" [Ref. 49:p. 25]. At this point, it is important to make an important distinction between the two forms of testing: pull-ups (chin-ups) require a bar from which to hang, while push-ups require nothing more than adequate, flat floor space.

c. Sit-reach

The sit-reach, currently a component of the PRT, is recommended by Stone as a method of evaluating lower back and hamstring flexibility [Ref. 24]. However, no single test can give a measure of overall flexibility [Ref. 47]. Greenberg and Pargman recommend additional tests which assess the flexibility of the arms, shoulders, and back. The quadriceps and hip flexors, primary muscles along the front of the thigh, and the calves are also proposed sites of flexibility tests. Nevertheless, it appears that two of the muscle groups most important to overall flexibility are the lower back and hamstring muscles, and the sit-reach test is the best method for measuring this feature [Ref. 47].

d. Discussion

It appears that each of the current test components are appropriate measures of the fitness aspect which they evaluate. Curl-ups were recommended as a measure of abdominal endurance in every physical fitness reference. Additionally, although pull-ups (chin-ups) were recommended as frequently as push-ups to measure

upper body strength, push-ups appear to be the best choice, due to the lack of equipment requirements. If one measure of flexibility is utilized, the sit-reach, which assesses lower back and hamstring flexibility, seems to be the best option. Much of the physical demands placed on sailors involve lifting, pulling, and carrying, all of which involve the lower back and upper leg portions of the body.

4. Body Composition

Prior to the distribution of DoD Directive 1308.1, the United States Navy utilized height-weight standards to screen its overweight members. Why, today, has the focus changed from weight to body composition? Visgaitis claims the original height-weight formulas devised by Metropolitan Life were biased; the only individuals incorporated within the study were those who bought life insurance. Furthermore, weight distribution and the fat-to-lean ratio is now considered far more important in predicting good health [Ref. 50].

In response to DoD Directive 1308.1, the Navy promulgated OPNAVINST 6110.1B, which directed that body fat standards be instituted as the basis for weight control [Ref. 51]. Initially, body fat was determined by plugging body circumference measurements into equations developed by Wright, Dotson, and Davis, as shown below [Ref. 52].

Women: Percent body fat = (1.051 * Biceps Circumference) -(1.522 * Forearm Circumference) - (0.879 * Neck Circumference) + (0.326 * Abdomen Circumference) + (0.597 * Thigh Circumference) + 0.707

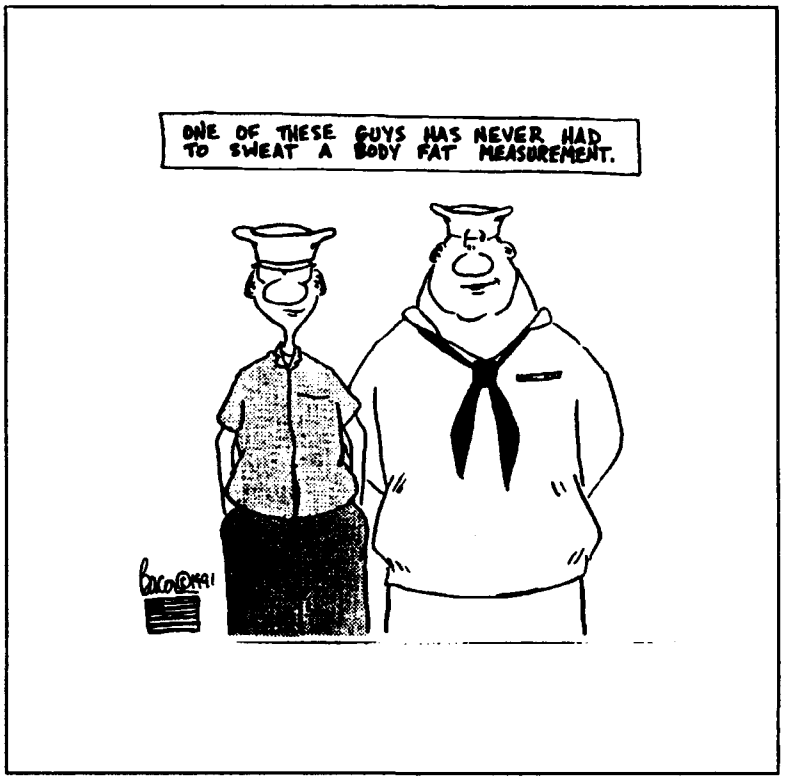
Men: Percent body fat = (0.74 * Abdomen Circumference) - (1.249 * Neck Circumference) + 0.529

In 1983, Hodgdon and Marcinik studied a sample of the Navy men, and from this analysis, determined that 15.8 percent of the Navy male population would exceed the body fat standard imposed by OPNAVINST 6110.1B [Ref 53]. Although this percentage did not vary much from the percentage that exceeded the height-weight standards at the time, the authors did conclude that the newly-imposed body fat measurements would impact more heavily on older personnel. As an individual ages, lean tissue gradually converts to fat. Because fat tissue is less dense, the person's circumferences can increase with little or no weight change. Therefore, older personnel who would still meet the height-weight standards would have more difficulty meeting the body fat standards.

Hodgdon and Beckett performed analyses in 1984 on the body fat content of Navy men and women, by comparing fat percentages obtained from the Wright, Dotson, and Davis tables to percentages derived from hydrostatic (immersion) procedures [Ref. 54, 55]. Correlation coefficients of 0.87 and 0.80 were calculated for the men and women. For both sexes, the equations were found to overpredict body fat in lean personnel and underpredict overfat individuals. These researchers developed equations (incorporating the member's height and reducing the number of circumference measurements for women) which resulted in higher correlation coefficients for both sexes.

Today, body fat measurement for Navy personnel is prescribed by OPNAVINST 6110.1D. Is this the best manner in which to assess percent body fat? Some members feel the current method does not accurately reflect true body fat percentages for members with

"extreme" measurements. Some of the sentiments concerning this method are best summed up by the Navy Times cartoon, "Broadside," as follows [Ref. 56].



5. Body Composition Assessment Methods

What options exist to measure body fat percentages? In the last 30 years, over 100 different prediction methods have been proposed to determine body composition [Ref 3]. The most popular methods include hydrostatic weighing, electrical resistance (bioelectric impedance), skin-fold calipers, infrared light measurement, and circumference measurements [Ref. 57]. The Navy must consider which method best combines ease of administration, cost, and accurate results.

a. Hydrostatic Weighing

Hydrostatic weighing is widely considered the "gold standard," against which other methods are compared [Ref 58]. This method involves weighing an individual while underwater and determining his or her body density. Due to equipment and time constraints, hydrostatic weighing is not considered an appropriate technique for large populations.

b. Bioelectric Impedance

The bioelectric impedance method measures the electrical resistance of the body's fat when a low-level current is introduced through the hand and foot. Hodgdon and Fitzgerald performed an analysis of this method and found that the results were not generalizable across wide ranges of body fat percentages [Ref. 59]. Additionally, numerous conditions must be imposed prior to testing, including limits on exercise, food, water, alcohol, and caffeine [Ref. 57].

c. Skin-fold Caliper

The skin-fold caliper method involves measuring the thickness of skin and underlying subcutaneous fat by grasping folds of skin with pincher-like calipers. Beckett and Hodgdon describe the proper technique for utilizing the calipers [Ref. 60]. Although this method requires little equipment or expense, there exists large inter-observer variability, and reproduction of results is often difficult [Ref. 61]. Operators need to know what sites to measure and how much tissue to pinch [Ref. 57].

d. Infrared Analysis

Infrared technology has been used in the fat measurement field for less than two years. Infrared light is passed through the body, and because fat refracts light differently than muscle (or bone), the fat tissue can be distinguished and measured. One

company, Futrex, makes a hand-held device it claims is more precise than hydrostatic weighing. This procedure utilizes technology developed ten years ago by the U.S. Department of Agriculture to measure fats, proteins, starches, and sugars in agricultural products. Futrex hopes to sell the device to the armed forces. They claim a home model will be marketed shortly which costs $290 [Ref. 62]. Researchers say the technology is promising but unproven [Ref. 57].

e. Circumference Measurement

The measurement of body circumference is one of the oldest techniques used to determine body composition. Proper site selection is imperative, but this method involves little training and is very inexpensive. Hodgdon and Beckett demonstrated that the current Navy method, outlined in OPNAVINST 6110.1D, is highly correlated with actual body fat percentages. The United States Air Force, after using a flexed bicep and height-weight measurement system, is considering adopting the current Navy method of body circumference measurement [Ref. 63].

6. Discussion

The Navy is faced with choosing the most appropriate method to analyze the body composition of its members. Accuracy is obviously a high priority, but this factor may be somewhat constrained by equipment costs and training requirements. With over 100 methods available to assess body composition, the Navy chose to utilize the body circumference measurement method. Until other means become less costly, require less training, and are more readily adaptable to measure a large number of subjects, the current method appears to be the best possible option.

Method preference is but one factor that policy makers must consider when dealing with the body fat issue. Health aspects and job fulfillment ability also play a key

role in the development of the weight control program. While overweight members have a higher risk of high blood pressure, heart disease, and other ailments, the services are reassessing and considering an increase in their current weight standards [Ref 64]. The Navy Personnel Research and Development Center (NPRDC) conducted studies to establish physical standards for different Navy jobs. Questions have been raised about whether weight and body-fat limitations, which decide entrance and continuance in the Navy, are an accurate measure of physical abilities. As David Robertson of NPRDC claims, "In our testing, we found that heavier people, including the fatter ones, can do the best jobs in handling, lifting, and moving heavy things" [Ref. 64:p. 28]. This is particularly important when dealing with female members, because men in the military complain that women are not able to perform many of the assigned physical tasks. Pentagon manpower officials have found that only five percent of the pool of potential male recruits were excluded from military service because of weight standards, but 28 percent of women were considered overweight. In 1987, the Air Force increased its maximum allowable weight for women by five percent, or six to nine pounds, depending on the member's height [Ref. 65].

C. PRT ADMINISTRATION

To ensure a more complete evaluation of the physical readiness test, specific difficulties concerning the administration and scoring of the PRT will also be addressed. Specifically, this section will examine the scale from which members' PRT performances are evaluated, and then focus on potential complication posed by ship deployments and by medically waived individuals. Finally, the attitudes and perceptions of Navy members concerning the PRT will be discussed.

1. PRT Scoring

a. Age Requirements

Each event in the physical readiness test is graded based on the number of repetitions performed (curl-ups and push-ups) or the time required to complete the event (1.5-mile run or 500-yard swim). A score of outstanding, excellent, good, satisfactory, or failure is assigned to each event, based on the number of points obtained (except the sit-reach, which is scored on a pass-fail basis only). For example, 45 curl-ups are worth 45 points, 45 push-ups are worth 78 points, and an 11:00-minute run is worth 83 points. (See Appendix E)

The final score of an individual is obtained by totaling the points achieved in each event. This point total determines the overall PRT score (outstanding, excellent, etc.) for the member. The number of points required for this cumulative score is based on the participant's age and sex. Although 45 push-ups are worth 78 points to both an 18-year-old woman, an 18-year-old man, and a 38-year-old man, the woman is required to accumulate a minimum of 142 points to pass the PRT, whereas the man must acquire a minimum of 188 total points to pass. A 38-year-old man would need only 144 points to achieve a satisfactory (minimum required to pass) score.

Allowing for differences in scores between men and women certainly appears reasonable, given the differences between male and female body types. Similarly, establishing requirements based on age also seems to be logical. However, each age group currently encompasses a 10-year span. In other words, the physical requirements of a 29-year-old man are the same as those of a 20-year-old man (168 total points to pass the PRT). And, yet, as soon as a man turns 30 years old, the total point requirement drops to 144. The minimum number of curl-ups decreases from 40 to 32 (20.0 percent decrease), and

push-ups from 29 to 23 (20.7 percent decrease). Another big difference can be found in the aerobic portion of the PRT. The run time increases from 13 minutes and 45 seconds to 15 minutes and 30 seconds. With the passage of just one year, an individual will suddenly be allowed almost two more minutes to pass the 1.5-mile run. This equates to a 12.7 percent increase in allotted time. Is there that much difference between a 39-year-old man and one who is 40?

Perhaps this 10-year span is too large. One possible alternative includes revising the age groupings to include smaller time spans with less drastic reductions in physical requirements between age groupings. For example, the 30- to 39-year-old grouping instead becomes two categories, a 30- to 34-year-old and a 35- to 39-year-old group. The current decrease in requirements between the 30-year-olds and 40-year-olds can now be averaged between the two groups that are formed. This would require the 30-year-old man to still perform 29 push-ups, and the 40-year- old man to still perform 23 push-ups. Now, however, th 35-year-old man would be required to do 26 push-ups. This would allow for an approximate 10-percent decrease in each of the five year spans, a much more reasonable estimation of physical requirements, based on age.

b. Aerobic Scoring

The aerobic portion of the PRT is based on 10-second increments. A 15-minute run is worth 59 points, whereas a run that takes 15 minutes and 10 seconds scores 58 points. This "10 seconds equals one point" scoring method is constant throughout the entire time table. Is this the best method to allocate points in this event?

Miller believes there is an inappropriate allocation of points in the run portion of the Marine Corps fitness test. Although one point is awarded for each ten seconds of improvement, he claims that "it is much easier to improve from 28:10 (minutes)

to 28:00 (minutes) than to improve from 18:10 (minutes) to 18:00 (minutes)." He suggests incorporating a sliding point scale to account for the differences in energy requirements [Ref 25:p. 28]. Although the run portion of the Navy PRT is only half the distance of the 3-mile Marine Corps requirement, the same philosophy would seem to apply. For example, an 11-second increment may be worth one point in the 13:00+ minutes range, a 10-second increment would be worth one point in the 10:00 to 13:00 minutes range, and a nine-second increment would be worth one point in the less than 10:00 minutes range. A sliding point scale for the aerobic portion may better reflect the difficulty associated with improving an already vigorous activity.

2. Deployment

Scheduled deployments of Navy vessels can greatly hinder the semi-annual physical readiness testing of its members. Space requirements may constrain the testing of large crews. Although the sit-reach, curl-up, and push-up portions of the PRT actually require little space, the 1.5-mile run poses specific difficulties. A 1.5-mile course aboard ship may consist of numerous laps around the deck. Dr. Ambrosha, cardiologist at the PRIMUS Clinic, located at the Presidio in Monterey, California, claims that a ship is not an appropriate place for an individual to run. Test participants are forced to contend with overhead and ground hazards, in addition to the motion of the ship. Furthermore, the hard surface on which participants must run increases the chance for injury, particularly shin splints [Ref. 66]. Although the ship's crew may take the test during a port call, there may be difficulty in finding a measured course.

The current option to the 1.5-mile run is the 500-yard swim. Obviously, no ships have the luxury of maintaining their own swimming pool. Therefore, one must examine other alternatives which measure a member's aerobic capacity. Once again, a

timed stationary bicycle ride appears to be a legitimate means of assessing aerobic fitness aboard ships. Space requirements are minimal, and the inclusion of such equipment aboard Navy vessels provides crew members another means of aerobic training.

3. Medical Waiver

An individual may be medically excused from any portion(s) of the PRT, or from the entire test. According to OPNAVINST 6110.1D, any medical conditions that require a partial or total exemption from the physical readiness test must be re-evaluated before each official PRT. If a medical waiver is granted for any portion of the test for three consecutive PRTs (over a minimum of 13 months), the member is subject to medical board referral.

The current system for handling medical waivers has the potential for abuse. The possibility exists for a member to be periodically excused due to medical waiver. Careful screening of medically waived individuals should reduce the likelihood of system abuse by those members who simply do not wish to take the test.

To further reduce the opportunity to "duck" the PRT through medical waiver, additional requirements should be implemented. For example, place restrictions on the transfer of individuals who have been medically waived, until they are able to complete and pass the PRT. More restrictions should also be placed on individuals who are medically waived on a recurring (but not consecutive) basis. Members who are waived from the PRT a particular number of times (for the same reason) within a certain time frame should also be evaluated by a medical board to determine if a chronic condition exists. Similarly, individuals who are waived a specific number of times within a certain time frame, but for different medical reasons, should also be evaluated by a medical board. Actions such as these should help to eliminate manipulation of the medical waiver system.

Further study should be conducted in this area to determine if the abuse of medical waivers actually occurs in the fleet.

4. Attitudes and Perceptions

In 1982, the Chief of Naval Operations established the Navy's Health and Physical Readiness Program (HAPR) to encourage healthful lifestyles among Navy personnel. As part of the HAPR, commands assess the physical fitness level and body composition their members through the PRT. How does the Navy view this evolution?

Earlier reference was made to personnel who "gut out" the PRT. These are the individuals who cannot be seen on the track or in the gym until a few days prior to administration of the PRT. When taking the test, they suffer needless discomfort, because they are not physically prepared. What can be done to encourage such individuals to be better prepared for the PRT? The semi-annual nature of the physical readiness test allows for Navy personnel to build up to a particular level of fitness, pass the PRT, and then decrease their fitness level. This cycle can be repeated every six months. Is the goal of the Navy to require its members to be in good physical shape only part of the time?

Perhaps an alternative to the semi-annual PRT would be to increase the administration frequency, for example, on a tri-annual or quarterly basis. If individuals prepare for the PRT in a cyclical manner, this would raise their minimal fitness level and decrease the amount of time they spend at their lowest fitness level.

Some members enjoy the benefits of a healthy, physically fit body, yet may not achieve their best possible score. What incentive is there for individuals to achieve "outstanding" on the PRT instead of merely meeting the minimum requirements? In their survey of 83 command fitness coordinators (CFCs), Conway, Trent, and Cronan found that only 41 percent of the CFCs reported that their commands offered incentives to members

who achieved a score of "outstanding." Furthermore, only 19 percent offered incentives for performance at any other level, or for showing big improvements in performance. However, 78 percent of the commands invoked negative consequences upon those members who failed the PRT [Ref. 67].

The need for positive recognition drives possible changes within the Navy. A system should be established that rewards those members who either achieve a score of "outstanding" or significantly improve their overall PRT performance. Perhaps a ribbon can even be awarded to those individuals who consistently achieve "outstanding" over a specified period of time. Although negative incentives need to be maintained, a positive reward system may improve the physical readiness of Navy personnel.

No matter how good a Navy program may be, it stands little chance of success if the commanding officers (COs) and executive officers are not willing to support it. Conway, Trent, and Cronan found that 17 percent of the surveyed CFCs reported "their COs did not exercise regularly, did not appear physically fit, were overweight, and did not provide strong support for either the CFC or the physical readiness program in general" [Ref. 67: p. 14]. All but one of the commands surveyed conducted the PRT, but more than 20 percent of the commands did not provide remedial programs for members who failed the test. Finally, while 74 percent of the COs encouraged exercise in general, and 82 percent encouraged weight control for those who needed it, only 54 percent encouraged exercise during the work day. Executive officer percentages were approximately the same as those of commanding officers [Ref. 67].

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The semi-annual physical readiness test (PRT), set forth by OPNAVINST 6110.1D, is designed to measure the physical fitness level of Navy members. An evaluation of the PRT and related research have led to the following conclusions:

1. The routine job task requirements of surface warfare officers do not appear to exceed the level of physical fitness needed to pass (with a score of "satisfactory") the current PRT.

2. Performance during strenuous damage control situations and sustained operations is probably enhanced by a high level of physical fitness.

3. The minimum standards required to pass the PRT are less stringent than those necessary to receive a commission from one of the three primary SWO accession points: the Naval Academy, Officer Candidate School, and Naval Reserve Officer Training Corps. Officer Candidate School and NROTC units share similar requirements, but Academy test requirements and standards differ significantly.

4. The 1.5-mile run appears to be an appropriate measure of aerobic fitness. The 500-yard swim is less effective in measuring this factor and does not compare well with the 1.5-mile run.

5. Curl-ups and push-ups are the best methods to assess torso and upper body endurance, respectively. The sit-reach is also an effective method to gauge flexibility.

6. The body circumference method is currently the best technique used by the Navy for assessing body composition (percent body fat). Other methods are available, but they are not suitable for use by the Navy at this time.

7. The 10-year time span for age categories (20-29 years, 30-39 years, etc.) appears too large. This causes PRT requirements to decrease too drastically when an individual changes age groups. This time span also assumes that the fitness level remains constant over a 10-year period.

8. The 1.5-mile run is scored by awarding one point per 10-second decrease in time. This is constant throughout the time scale, and does not accurately reflect the fitness requirements necessary to improve an 8:00-minute run as compared to a 13:00-minute run.

9. Ship deployments make PRT administration difficult, particularly the 1.5-mile run, which may be hazardous when performed aboard ship.

10. The current method of medical waiver evaluation leaves the system open for abuse. Since three consecutive waivers (within 13 months) are required before an individual is referred to a medical board, it is possible for members to alternate between participation and waiver without consequence.

11. Many individuals do not maintain a consistent level of fitness, but rather intensify their workouts immediately prior to the PRT, and then allow their fitness level to drop after they complete the test. The six-month time span between PRTs allows for, and perhaps promotes, this cyclical performance.

12. Command support of the PRT is lacking to some extent. There appears to be a significant number of commanding officers who do not promote the PRT and physical fitness. Remedial and incentive programs may be lacking and many commanding officers do not attempt to set a good example.

B. RECOMMENDATIONS

Recommendations to improve the physical readiness test include the following:

1. Discard the 500-yard swim as a measure of aerobic fitness, and instead institute a standardized stationary bicycle ride as an alternative to the 1.5-mile run. Ensure proper equipment is available to all commands, ashore and afloat.

2. Continue usage of the curl-ups, push-ups, and sit-reach as fitness measures in the PRT.

3. Continue usage of the body circumference technique to assess body composition. However, the use of infrared technology shows promise, and the possibility of utilization should be pursued.

4. Decrease the time span separating age groups from 10 years to five years. This would result in new categories such as 20-24 years, 25-29 years, etc.

5. Place the aerobic portion of the PRT on a sliding scale. For example, a 10-second improvement in the 13:00 to 15:00-minute range is worth one point, whereas a 9-second improvement in the 10:00 to 12:59-minute range is worth one point. This makes it slightly easier to achieve points as one decreases the total time required to complete the event, and would account for the difficulty required to improve an already high level of performance.

6. Increase PRT administration from a semi-annual to a quarterly event.

Other recommendations concerning PRT issues are as follows:

1. Align all accession point physical requirements with those prescribed by OPNAVINST 6110.1D. However, maintain the requirement of scoring "good," rather than the fleet requirement of "satisfactory." This does not mean the Naval Academy should eliminate events such as the obstacle course, but rather, for commissioning purposes, administer their fitness assessment in accordance with OPNAVINST 6110.1D. Additionally, an alternative to the 1.5-mile run should not be offered except in the case of medical necessity, which would require a low-impact activity.

2. Further study should be conducted on individuals who are medically waived from the PRT to determine if the system is being abused. If abuse is occurring, several remedies are possible. For example, do not allow transfer of any member who has been medically waived for two consecutive PRTs. Furthermore, allow medical board evaluation for any member who is a) waived three times for the *same* reason within four PRTs, or b) waived three times for *different* reasons within six PRTs.

3. Offer command awards to "most improved" individuals, and those who achieve a score of "outstanding." Implement a Navy-wide award for those members who achieve five consecutive scores of "outstanding."

4. Offer awards to commands for overall PRT performance. This may include command fitness as part of the Battle Efficiency "E" award among surface ships, and similar awards among other shore commands.

These steps, if implemented, would improve the quality of the Navy's physical readiness test. Furthermore, equality would be established throughout the three major commissioning sources. Each potential officer would be held to the same physical requirements, no matter which commissioning source he or she attends. Finally, the potential for abuse of the medical waiver system would be reduced, and command support of the PRT would improve.

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Name (Last, First, MI)	Rate/Rank	Dept	Division	Social Security No.	Date of Birth	Sex

OPNAVINST 6110.1D
RCS OPNAV 6110-6

Risk Factor Screening / Physical Readiness Test Results

Page 1

Section A - Current Physical Examination *(To be completed by an authorized medical department representative (AMDR) at the time of each periodic physical examination.)*												
Date of Examination *(mm/dd/yy)*												
Date of Next Required Examination *(mm/dd/yy)*												
Member is medically cleared for participation in the Physical Readiness Test (PRT) and a physical conditioning program	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
AMDR's Signature												
Physical Readiness Test (To be completed by CFC)	Date:		Date:		Date:		Date:		Date:		Date:	
Section B - Risk Factor Questionnaire *(Place an "X" in the appropriate block)*												
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
1. Are you now 45 or older and not accustomed to the level of exercise involved in the PRT?												
Since your last periodic physical or PRT has there been a:												
2. Significant change in your history of heart disease or high blood pressure which required you to restrict physical activity or seek medical treatment?												
3. Significant change in your incidence of discomfort in your chest, arms, or neck while exercising?												
4. Significant change in your incidence of fainting or feeling you were about to lose consciousness?												
5. Significant change in any medical condition (such as diabetes, asthma, or bone or joint disease) which you think might limit your participation in the PRT or a physical conditioning program?												
6. Significant change in your family history such that your mother, father, brother, or a sister had a heart attack or died of heart disease before they were 45 years old?												
7. Significant change in your condition of obesity?												
8. Significant change in your smoking habits such that you now smoke more than two packs of cigarettes daily?												
Date Section B Completed *(mm/dd/yy)*												
Member's Signature												
Section C - Body Composition Screen *(To be completed by CFC).*												
Date Completed *(mm/dd/yy)*												
1. Height *(without shoes in inches (nearest ½ inch):*												
2. Weight *(in shorts/pt gear and without shoes)* (Pounds)												
3. Neck *(Round up to nearest ½ inch)*												
4. Abdomen *(Males only) (Round down to nearest ½ inch)*												
5. Natural Waist *(Women only) (Round down to nearest ½ inch)*												
6. Hip *(Women only) (Round down to nearest ½ inch)*												
7. % Body Fat												

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Name (Last, First, MI)	Rate/Rank	Dept	Division	Social Security No.	Date of Birth	Sex

OPNAVINST 6110.1D
RCS OPNAV 6110-4

Section D - Medical Referral *(To be completed by CFC - Place an "X" in the appropriate boxes)*												
Date of Referral *(mm/dd/yy)*												
Refer member to medical for any of the following: 1. At the time of the last periodic physical examination (Section A) the member was not cleared to participate in the PRT or a command physical conditioning program.												
2. Periodic physical examination is not current.												
3. Member answered "yes" to any question 1-8 of Section B.												
4. Male member is ≥ 26% or female member is ≥ 36% body fat												
Section E - Medical Evaluation *(To be completed by Medical Officer, Nurse Practitioner or Physician's Assistant)*												
Obesity Assessment												
1. Enter percent body fat value determined using circumference measurements.												
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
2. Based on medical evaluation answer the following questions												
a. Is member overfat? (Male > 22% to < 26%) (Female > 30% to < 36%)												
b. Is member obese? (Male ≥ 26%) (Female ≥ 36%)												
3. Medical Recommendation:												
a. Cleared for participation in command directed physical conditioning program												
b. Referred for appropriate medical consultation or rehabilitation (e.g., psychology, nutrition, internal medicine, physical therapy, patient education)												
c. Provided return appointment to this medical facility.												
d. Recommended for appropriate obesity rehabilitation program beyond a command directed physical conditioning program, if eligible.												
4. Waivers *(Except for those diagnosed obese)*												
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Based on a medical examination this member is medically authorized to participation in this PRT and associated physical conditioning program as follows:												
a. PRT Sit - reach												
b. PRT Curl - ups												
c. PRT Push - ups												
d. PRT Run / Walk												
e. PRT Swim												
f. Command Directed Physical Conditioning Program												
Date of Examination *(mm/dd/yy)*												
AMDR's Signature												

Section F - Physical Readiness Results *(To be completed by CFC)* Page 3

	PRT No.:			PRT No.:			PRT No.:		
Name of Command / UIC									
Date of Test *(mm/dd/yy)*	DATE:	AGE ON DATE OF TEST		DATE:	AGE ON DATE OF TEST		DATE:	AGE ON DATE OF TEST	
Items	**Raw Score**	**PTS**	**Category**	**Raw Score**	**PTS**	**Category**	**Raw Score**	**PTS**	**Category**
1. Sit-reach									
2. Curl-ups									
3. Push-ups									
4. 1.5 mile run/walk or									
5. 500 yard swim									
6. Overall classification									
Member's signature:									
CFC's signature:									

	PRT No.:			PRT No.:			PRT No.:		
Name of Command / UIC									
Date of Test *(mm/dd/yy)*	DATE:	AGE ON DATE OF TEST		DATE:	AGE ON DATE OF TEST		DATE:	AGE ON DATE OF TEST	
Items	**Raw Score**	**PTS**	**Category**	**Raw Score**	**PTS**	**Category**	**Raw Score**	**PTS**	**Category**
1. Sit-reach									
2. Curl-ups									
3. Push-ups									
4. 1.5 mile run/walk or									
5. 500 yard swim									
6. Overall classification									
Member's signature:									
CFC's signature:									

Section G - Command Directed Physical Conditioning Program *(To be completed by CFC)*

Items	Raw Score	PTS	Category	Raw Score	PTS	Category	Raw Score	PTS	Category
1. % Body Fat									
2. Sit-reach									
3. Curl-ups									
4. Push-ups									
5. 1.5 mile run/walk or									
6. 500 yard swim									
7. Overall classification									
Date of Assessment *(mm/dd/yy)*	DATE	AGE ON DATE OF ASSESSMENT		DATE	AGE ON DATE OF ASSESSMENT		DATE	AGE ON DATE OF ASSESSMENT	

Items	Raw Score	PTS	Category	Raw Score	PTS	Category	Raw Score	PTS	Category
1. % Body Fat									
2. Sit-reach									
3. Curl-ups									
4. Push-ups									
5. 1.5 mile run/walk or									
6. 500 yard swim									
7. Overall classification									
Date of Assessment *(mm/dd/yy)*	DATE	AGE ON DATE OF ASSESSMENT		DATE	AGE ON DATE OF ASSESSMENT		DATE	AGE ON DATE OF ASSESSMENT	

	Date *(mm/dd/yy)*	Date *(mm/dd/yy)*	Date *(mm/dd/yy)*	Date *(mm/dd/yy)*	Date *(mm/dd/yy)*	Date *(mm/dd/yy)*
1. Page 13 entry						
2. Message sent to NMPC						
3. Started Program						
4. Completed Program						

PRIVACY ACT STATEMENT

AUTHORITY: *Title 5, U.S. Code, 301, OPNAVINST 6110.1D*

PRINCIPAL PURPOSE: *To provide the command Fitness Coordinator with the necessary information to screen personnel for potential health risks prior to physical readiness testing and to record test results.*

ROUTINE USE: *For official and employees of the Department of the Navy in performing their official duties of administering the Health and Physical Readiness Program.*

MANDATORY DISCLOSURE AND CONSEQUENCES OF REFUSAL TO DISCLOSE: *Disclosure is necessary to fully evaluate member's readiness to participate in mandatory physical readiness testing. Failure to provide the requested information may preclude participation in physical readiness testing and may warrant further medical evaluation or administrative action.*

APPENDIX B

OPNAVINST 6110.1D
AGE AND GENDER CATEGORIES

	17-19 YRS.		20-29 YRS.		30-39 YRS.		40-49 YRS.		50+ YRS.	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
SIT-REACH										
Pass/Fail	Touch Toes		Touch Toes		Touch Toes		Touch Toes		Touch Toes	
CURL-UPS (2 MINUTES										
Outstanding	88	86	84	84	75	74	73	72	68	67
Excellent	72	67	68	61	54	54	48	48	45	45
Good	60	52	50	45	40	39	35	34	33	32
Satisfactory	45	40	40	33	32	27	29	24	27	22
PUSH-UPS (2 MINUTES)										
Outstanding	62	38	52	29	45	23	41	22	38	21
Excellent	57	31	48	24	41	19	37	18	35	18
Good	51	24	42	17	36	11	32	11	30	10
Satisfactory	39	18	29	11	23	5	20	5	19	5
1.5 MILE RUN/WALK										
Outstanding	9:00	11:30	9:15	11:30	10:00	12:00	10:15	12:15	10:45	12:45
Excellent	9:45	13:15	10:30	13:30	11:45	13:45	12:15	14:15	12:30	14:45
Good	11:00	15:00	12:00	15:00	13:45	15:30	14:30	16:15	15:15	16:45
Satisfactory	12:45	16:15	13:45	16:45	15:30	17:15	16:30	18:15	17:00	19:00
500 YARD SWIM										
Outstanding	8:00	9:15	8:00	9:15	10:15	12:15	11:15	13:15	11:45	13:45
Excellent	9:45	13:15	10:30	13:30	11:45	13:45	12:15	14:15	12:30	14:45
Good	11:30	14:15	11:30	14:15	14:15	15:45	15:15	16:45	15:45	17:30
Satisfactory	13:15	17:00	13:15	17:00	15:45	17:15	16:45	18:30	17:30	19:15

REQUIRED POINT SCORES

	17-19 YRS.		20-29 YRS.		30-39 YRS.		40-49 YRS.		50+ YRS.	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
FOR MEMBERS WHO DO THE 1.5 MILE RUN/WALK										
Outstanding	278	235	262	226	242	207	234	202	223	193
Excellent	252	199	235	187	206	172	193	162	187	155
Good	227	168	202	154	175	139	162	129	153	123
Satisfactory	189	142	168	125	144	92	132	83	126	77
FOR MEMBERS WHO DO THE 500 YARD SWIM										
Outstanding	283	248	269	236	241	208	230	200	220	192
Excellent	253	212	240	199	209	177	196	167	188	166
Good	226	177	207	163	177	144	163	134	157	138
Satisfactory	189	149	175	132	149	100	138	91	131	75

APPENDIX C
NPS SURVEY

FROM: LT. BILL HATCH / LT. LORI SWINNEY

TO: NPGS SURFACE WARFARE OFFICERS

SUBJ: NAVY PHYSICAL READINESS TEST (PRT) QUESTIONNAIRE

1. WE ARE CONDUCTING THESIS RESEARCH ON HOW WELL THE PRT SUPPORTS THE ROUTINE OF SURFACE WARFARE OFFICERS.

2. PLEASE COMPLETE THE FOLLOWING SURVEY AND **RETURN** IT TO **SMC BOX 1120.**

3. LET **all** ANSWERS REFLECT YOUR MOST RECENT SEA TOUR.

GENERAL INFO

1. AGE: ☐ 20-29 ☐ 30-39 ☐ 40-49

2. SEX: ☐ MALE ☐ FEMALE

3. SHIP TYPE(i.e. AO, FF, CG,): _____

4. BILLET: ☐ OPS ☐ WEPS ☐ ENG ☐ A N

PRT INFO

5. LATEST SHIPBOARD PRT SCORE.

- ☐ MEDICAL WAIVER
- ☐ FAIL
- ☐ SATISFACTORY
- ☐ GOOD
- ☐ EXCELLENT
- ☐ OUTSTANDING

6. PERCENT BODY FAT

- ☐ LESS THAN 16%
- ☐ 16-19%
- ☐ 20-22%
- ☐ 23-24%
- ☐ 25-30%
- ☐ 31-35%
- ☐ GREATER THAN 35%

7. DO YOUR SHIPBOARD TASKS DEMAND A HIGHER LEVEL OF FITNESS THAN THAT REQUIRED TO PASS THE PRT?

☐ YES ☐ NO

8. IF YES TO NUMBER 7. THEN INDICATE WHICH AREA OF FITNESS DOES NOT SUPPORT THESE TASKS.

- ☐ UPPER BODY STRENGTH
- ☐ LOWER BODY STRENGTH
- ☐ FLEXIBILITY
- ☐ AEROBIC CAPACITY

9. WHICH OF THE FOLLOWING ROUTINE TASKS DID YOU PERFORM. YOU MAY CHOOSE MORE THAN ONE ANSWER.

- ☐ STANDING 4 OR MORE HOURS
- ☐ OPEN CLOSE WTD. WTR. WTS
- ☐ CLIMBING LADDERS
- ☐ LIFTING
- ☐ CARRYING
- ☐ OTHER _____

APPENDIX D
OFFICER SURVEY INSTRUMENT

32. PHYSICAL FITNESS

A. Does your job demand a higher level of physical fitness than that required to meet the "satisfactory" performance level on the semi-annual physical readiness test (PRT)?

① NO
② YES

B. What was the result of your performance on your last official PRT?

① TOTAL MEDICAL WAIVER
② UNSATISFACTORY (FAILED)
③ SATISFACTORY (PASSED)
④ GOOD
⑤ EXCELLENT
⑥ OUTSTANDING

C. Does command policy provide time during the workday to exercise?

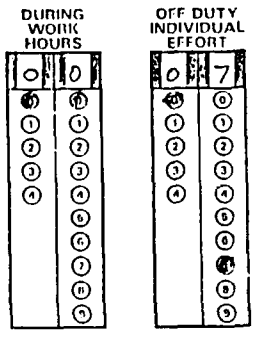
① NO
② YES

D. Do you feel that you have sufficient time and opportunity to exercise in addition to performing your work duties?

① ABSOLUTELY NEVER ENOUGH
② GENERALLY NEVER ENOUGH
③ MIXED, ABOUT 50/50
④ OFTEN ENOUGH
⑤ GENERALLY ENOUGH
⑥ ALWAYS ENOUGH

E. Indicate the average number of HOURS PER WEEK you spend in vigorous physical exercise designed to improve cardiovascular fitness (e.g., swimming, bicycling, jogging, basketball, etc.).

EXAMPLE: If you PT 4 hours during working hours and none during your off duty time, enter "04" on the work hours scale and leave the off duty scale blank.



APPENDIX E

OPNAVINST 6110.1D (POINT TABLE)

COLUMN A: POINTS FOR EVENTS
COLUMN B: NUMBER CURL UPS PERFORMED
COLUMN C: NUMBER PUSH UPS PERFORMED
COLUMN D: RUN/WALK TIME
COLUMN E: SWIM TIME

A	B c/u	C p/u	D run	E swim	A	B c/u	C p/u	D run	E swim
100	100	67	8:10	8:10	50	50	17	17:30	18:00
99	99	66	8:20	8:12	49	49	16	17:40	18:12
98	98	65	8:30	8:24	48	48	15	17:50	18:24
97	97	64	8:40	8:36	47	47	14	18:00	18:36
96	96	63	8:50	8:48	46	46	13	18:10	18:48
95	95	62	9:00	9:00	45	45	12	18:20	19:00
94	94	61	9:10	9:12	44	44	11	18:30	19:12
93	93	60	9:20	9:24	43	43	10	18:40	19:24
92	92	59	9:30	9:36	42	42	9	18:50	19:36
91	91	58	9:40	9:48	41	41	9	18:00	19:48
90	90	57	9:50	10:00	40	40	9	18:10	20:00
89	89	56	10:00	10:12	39	39	9	18:20	20:12
88	88	55	10:10	10:24	38	38	9	18:30	20:24
87	87	54	10:20	10:36	37	37	9	18:40	20:36
86	86	53	10:30	10:48	36	36	9	18:50	20:48
85	85	52	10:40	11:00	35	35	8	19:00	21:00
84	84	51	10:50	11:12	34	34	8	19:10	21:12
83	83	50	11:00	11:24	33	33	8	19:20	21:24
82	82	49	11:10	11:36	32	32	8	19:30	21:36
81	81	48	11:20	11:48	31	31	8	19:40	21:48
80	80	47	11:30	12:00	30	30	7	19:50	22:00
79	79	46	11:40	12:12	29	29	7	20:00	22:12
78	78	45	11:50	12:24	28	28	7	20:10	22:24
77	77	44	12:00	12:36	27	27	7	20:20	22:36
76	76	43	12:10	12:48	26	26	7	20:30	22:48
75	75	42	12:20	13:00	25	25	6	20:40	23:00
74	74	43	12:30	13:12	24	24	6	20:50	23:12
73	73	42	12:40	13:24	23	23	6	21:00	23:24
72	72	41	12:50	13:36	22	22	6	21:10	23:36
71	71	40	13:00	13:48	21	21	6	21:20	23:48
70	70	39	13:10	14:00	20	20	5	21:30	24:00
69	69	40	13:20	14:12	19	19	5	21:40	24:12
68	68	39	13:30	14:24	18	18	5	21:50	24:24
67	67	38	13:40	14:36	17	17	5	22:00	24:36
66	66	37	13:50	14:48	16	16	5	22:10	24:48
65	65	38	14:00	15:00	15	15	4	22:20	25:00
64	64	37	14:10	15:12	14	14	4	22:30	25:12
63	63	36	14:20	15:24	13	13	4	22:40	25:24
62	62	35	14:30	15:36	12	12	4	22:50	25:36
61	61	34	14:40	15:48	11	11	4	23:00	25:48
60	60	32	14:50	16:00	10	10	3	23:10	26:00
59	59	31	15:00	16:12	9	9	3	23:20	26:12
58	58	30	15:10	16:24	8	8	3	23:30	26:24
57	57	29	15:20	16:36	7	7	3	23:40	26:36
56	56	28	15:30	16:48	6	6	3	23:50	26:48
55	55	27	15:40	17:00	5	5	2	24:00	27:00
54	54	26	15:50	17:12	4	4	2	24:10	27:12
53	53	25	16:00	17:24	3	3	2	24:20	27:24
52	52	24	16:10	17:36	2	2	2	24:30	27:36
51	51	23	16:20	17:48	1	1	2	24:40	27:48